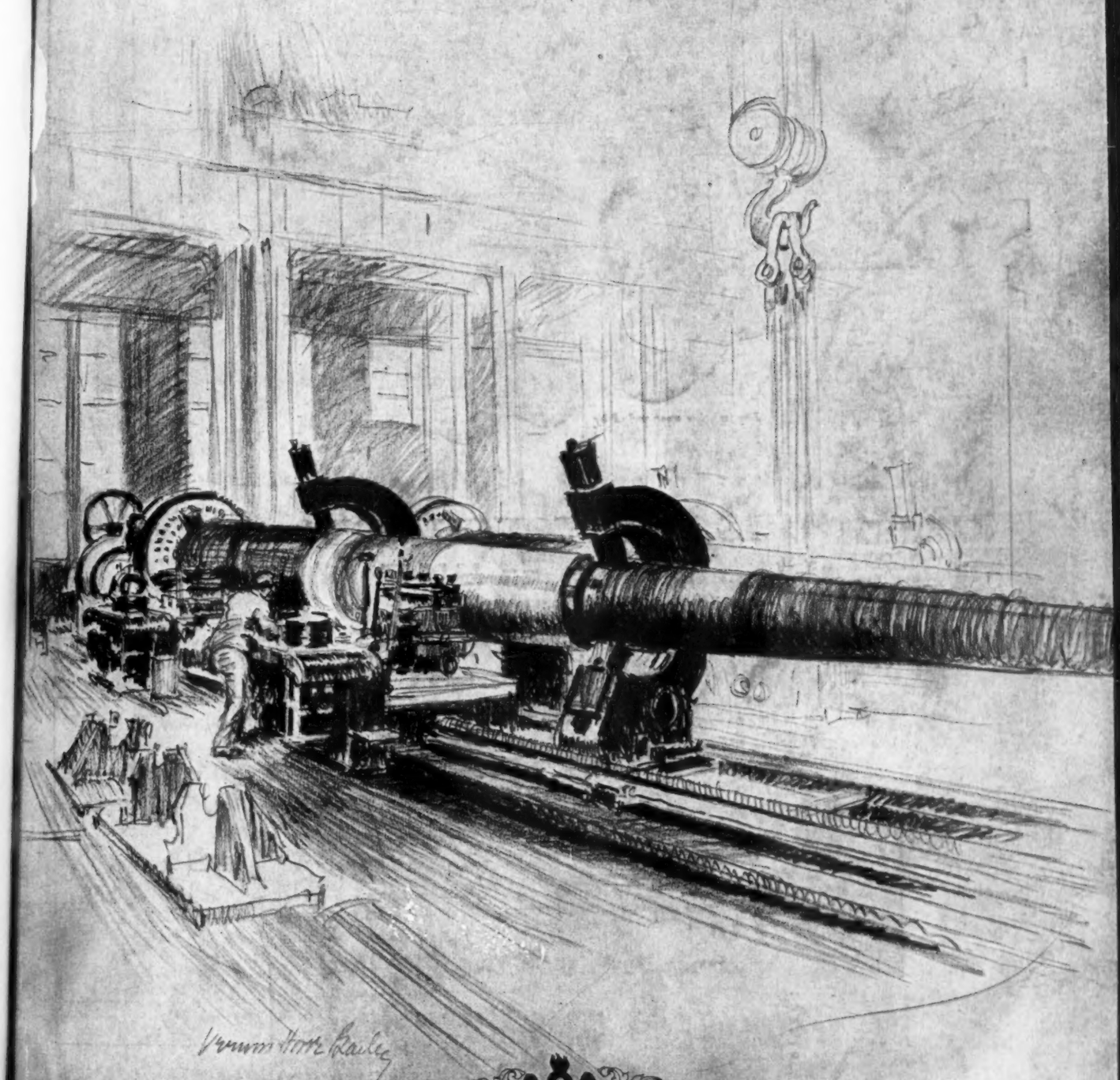
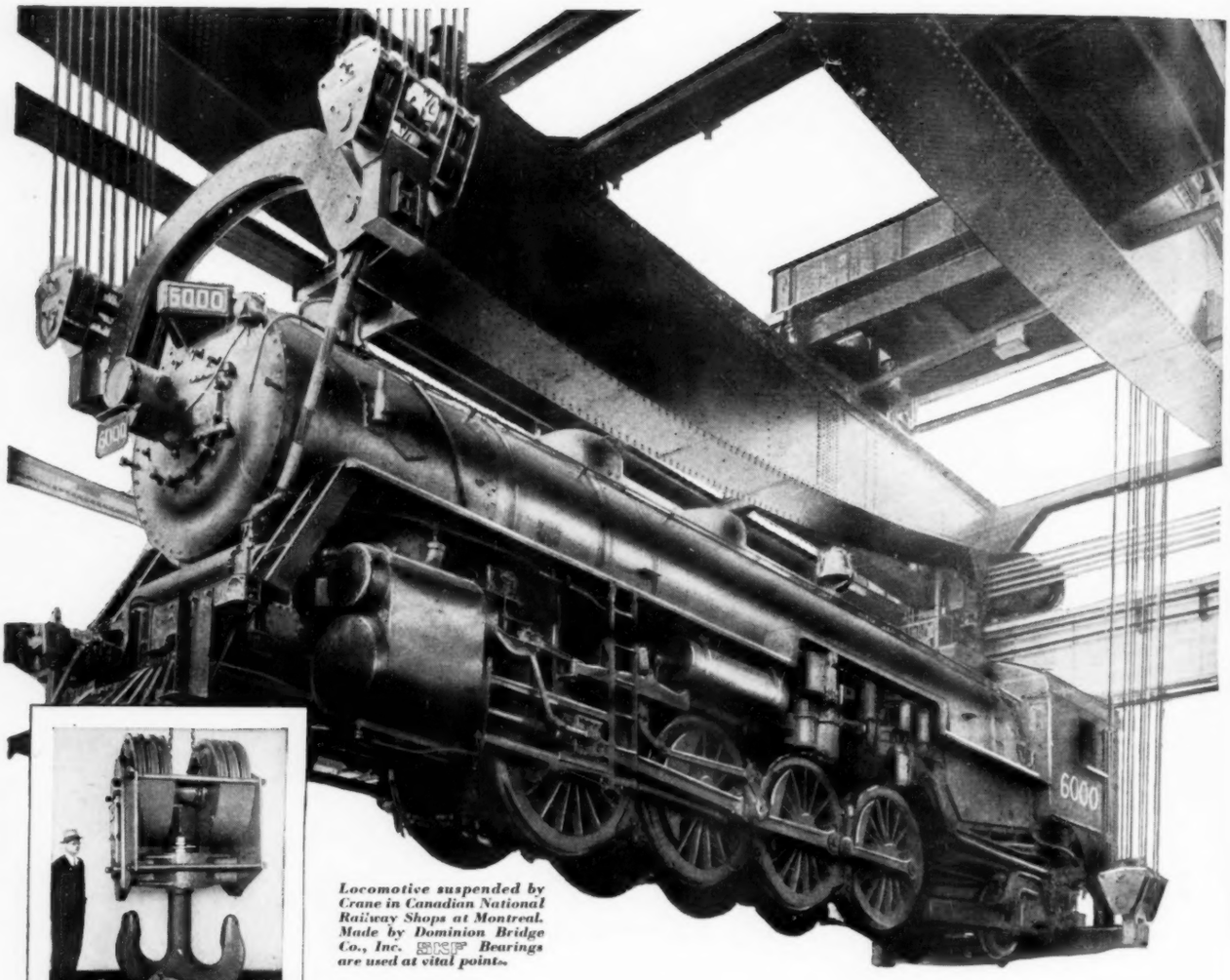
DEC 13 1930

ARMY ORDNANCE

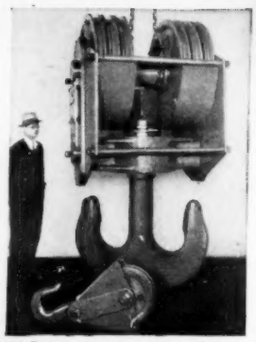


AOA

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION



Locomotive suspended by Crane in Canadian National Railway Shops at Montreal. Made by Dominion Bridge Co., Inc. SKF Bearings are used at vital points.



175 TON SKF *equipped Crane Hook Block built by Bedford Foundry and Machinery Co., Bedford, Ind., for the Salud River Project.*

IS IT A TOUGH JOB?

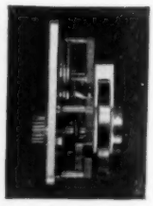
. . . then it's an SKF *job!*

CHECK up on *that* statement yourself. Look for evidence of it in the journals of fast railway passenger coaches. Test it out again by inquiring into the kind of bearings that go into great milling machines, great crushing machines, mammoth river dredges.

And yet—strength . . . the ability to stand up and perform under gruelling punishment is only one of the features of SKF Anti-Friction Bearings. Precision—precision that is drawn as finely as one-half of one-ten-thousandth of an inch—is another factor that makes SKF the preferred bearing throughout the world.

No matter what *your* bearing problem may be, put it up to SKF.

SKF INDUSTRIES, INC., 40 East 34th St., New York, N.Y.



SKF Bearings are also used on delicate scientific instruments where the demand is for extreme precision instead of extreme strength.

Hook of **480 TON** *Portal Crane made for the French Government and equipped throughout with SKF Bearings.*

SKF

2570

"THE HIGHEST PRICED BEARING IN THE WORLD"

ARMY ORDNANCE

The Journal of the Army Ordnance Association

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

Published by the Army Ordnance Association, The Mills Building, Washington, D. C. L. A. Codd, Editor.

Authors alone are responsible for statements made and opinions expressed in their respective articles.

Copyright, 1930.

Issued Bimonthly. Single Copy 75c.

Subscription rate: Continental U. S. $4.50 per annum, foreign $5.00, in advance. Entered as second-class matter August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional entry at Richmond, Va.

Volume XI **NOVEMBER-DECEMBER, 1930** **No. 63**

CONTENTS

		PAGE
"In the Gun Shop"	Drawing by Vernon Howe Bailey	Front Cover
Brig. Gen. William H. Tschappat, Ord. Dept., U. S. Army		Frontispiece
The Control of Industry in War	By Frederick H. Payne	181
Industrial Relations of Ordnance	By Maj. Gen. Samuel Hof	183
Educational Orders for Munitions	By Ernest T. Trigg	185
The Universal Gun Mount, T3	By G. M. Barnes	187
The Development of Army Ordnance	By Brig. Gen. William H. Tschappat	191
Smokeless Powder Grains	By A. J. Phillips	195
A Method for the Survey of Industry	By Walter Soderholm	199
Simulation of Setback of a Projectile	By I. A. Luke	205
Our Twelfth Annual Meeting:		
Part I. Proceedings of the Business and Technical Session		209
Part II. The Tests and Demonstrations at Aberdeen		211
Training Ordnance Reserve Officers	By Edward F. Miller	213
Editorial		217
Election of Officers and Directors—Unity of Control—Industrial Mobilization in Germany—Sir Philip Gibbs Moralizes—Congratulations and Thanks—A Step Forward in Industrial War Planning.		
Professional Notes		221
France to Test Automatic Guns—The 1930 Antiaircraft Exercises—Air-cooled Machine Guns Increase Fire Power of Cavalry—New Antiaircraft Sight for Machine Guns—Prize Competition for Arc Welding—Infantry Shooting Maintains High Standard—Carrier Pigeons Still Depended on in Battle—The Autogyro as an Instrument of Defense—Old Destroyers to be Bombed—Reservists Study Procurement Planning.		
Note and Comment		225
Hail and Farewell—Whittling to Fame—Methods of Testing Weapons Have Changed—Nansemond.		
Association Affairs		228
New Members—Necrology—Association Membership.		
Book Reviews		230
Foreign Reviews		234
Index of Advertisers		251

ARMY ORDNANCE ASSOCIATION

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

OFFICERS

Vice-President
WILLIAM W. COLEMAN
Milwaukee, Wis.

President
BENEDICT CROWELL
Cleveland, Ohio

Vice-President
WILLIAM C. SPRUANCE
Wilmington, Del.

Counsel
JOHN ROSS DELAFIELD
New York, N. Y.

Treasurer
CHAS. ELLIOT WARREN
New York, N. Y.

Secretary
L. A. CODD
Washington, D. C.

Directors

ROBERT P. LAMONT
Chicago, Ill.

FRANK A. SCOTT
Cleveland, Ohio

SAMUEL MCROBERTS
New York, N. Y.

CHARLES H. TENNEY
Boston, Mass.

C. L. HARRISON
Cincinnati, Ohio

RALPH M. DRAVO
Pittsburgh, Pa.

JOHN C. JONES
Philadelphia, Pa.

JAMES L. WALSH
New York, N. Y.

BRUCE CORNWALL
San Francisco, Calif.

SPENCER G. KUHN
Cincinnati, Ohio

HARRY SCULLIN
St. Louis, Mo.

PLINY E. HOLT
Stockton, Calif.

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our Nation's strongest guarantee of peace.

THE Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

THE Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times coöperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace Insurance" in this form is the foremost aim of the Army Ordnance Association.

THE Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the Nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the Nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the Industry of the Nation and by the Officers and Civilian Employees of the Ordnance Department in the wars in which the United States has been engaged.

ARMY ORDNANCE ASSOCIATION
The Mills Building, Pennsylvania Ave. at 17th St., N. W.
Washington, D. C.

LOCAL POSTS A.O.A.

NEW YORK

(*Organized June* 15, 1921)

President: JAMES L. WALSH. *1st Vice-President:* SAMUEL MCROBERTS. *2nd Vice-President:* H. B. MACHEN. *3rd Vice-President:* F. W. ROLLER. *4th Vice-President:* J. E. MCNARY. *Executive Committee:* THE OFFICERS and CHARLES ELLIOT WARREN, JOHN ROSS DELAFIELD, J. M. BOYLE, C. T. HARRIS, JR., C. W. RICE and T. A. MORGAN. *Treasurer:* CHARLES W. REED. *Secretary:* PHILIP R. FAYMONVILLE, 39 Whitehall Street, New York City.

CALIFORNIA

(*Organized October* 17, 1923)

President: PLINY E. HOLT. *Vice-President:* CHARLES N. BLACK. *Directors:* D. C. JACKLING, W. H. OLIVER L. F. FULLER, J. J. THOMAS, M. M. MITCHELL, BRUCE CORNWALL, THEODORE J. HOOVER, SAMUEL KAHN. *Secretary:* M. L. BRETT, 58 Sutter Street, San Francisco, Calif.

CHICAGO

(*Organized May* 3, 1924)

President: A. K. HAMILTON. *Vice-President:* F. A. LORENZ. *Directors:* E. J. BUFFINGTON, R. P. LAMONT, E. A. RUSSELL, W. C. YOUNG, W. R. WRIGHT, O. H. WURSTER. *Secretary and Treasurer:* W. H. SODERHOLM, 600 W. Jackson Boulevard, Chicago, Ill.

BOSTON

(*Organized June* 30, 1925)

President: R. F. WHITELEGG. *Vice-President:* NATHANIEL C. NASH, JR. *Directors:* GEORGE L. GILMORE, EVERETT MORSS, GEORGE P. SLADE, EDWARD F. MILLER, JAMES S. SMYSER and JAMES F. MONAGHAN. *Secretary-Treasurer:* ROGER TAYLOR, 75 Federal Street, Boston, Mass.

WASHINGTON

(*Organized November* 18, 1925)

President: C. G. METTLER. *Vice-Presidents:* HENRY P. ERWIN, CHAS. E. MUNROE. *Directors:* C. C. WILLIAMS, ROBERT P. LAMONT, SWAGAR SHERLEY, HOWARD BRUCE, GEO. B. MCCLELLAN, FRED E. WRIGHT, LEROY HODGES. *Treasurer:* C. E. MCRAE. *Secretary:* H. A. STRONG, Munitions Building, Washington, D. C.

CINCINNATI

(*Organized December* 10, 1925)

President: SPENCER G. KUHN. *Vice-President:* LUCIEN WULSIN. *Directors:* J. WALLACE CARREL, CHAS. HAKE, JR., FRED V. GEIER, GEO. B. KING, FRED W. HINKLE, CHAS. L. HARRISON, HARRY L. CAMPBELL, WILL C. JAMES, ROBERT F. TAFT. *Secretary-Treasurer:* CHARLES A. WALKER, 730 Southern Railway Building, Cincinnati, Ohio.

PHILADELPHIA

(*Organized December* 9, 1926)

President: PHILIP H. GADSDEN. *Vice-Presidents:* WILLIAM C. SPRUANCE, ERNEST T. TRIGG. *Directors:* J. W. RAWLE, CHARLES DAY, THOMAS S. GATES, CHARLES Z. TRYON, J. L. POULTNEY, J. W. ROBBINS. *Secretary:* W. L. CLARK, 1205 Gimbel Building, Philadelphia, Pa.

ST. LOUIS

(*Organized January* 18, 1927)

President: HARRY SCULLIN. *Vice-President:* E. D. CAMPBELL. *Directors:* J. M. KURN, J. W. JARBOE, A. J. DAVIS, E. D. NIMS, M. E. SINGLETON, W. F. CARTER, J. M. OLIN, H. I. FINCH. *Secretary-Treasurer:* L. J. DILLON, Southwestern Bell Telephone Building, St. Louis, Mo.

PITTSBURGH

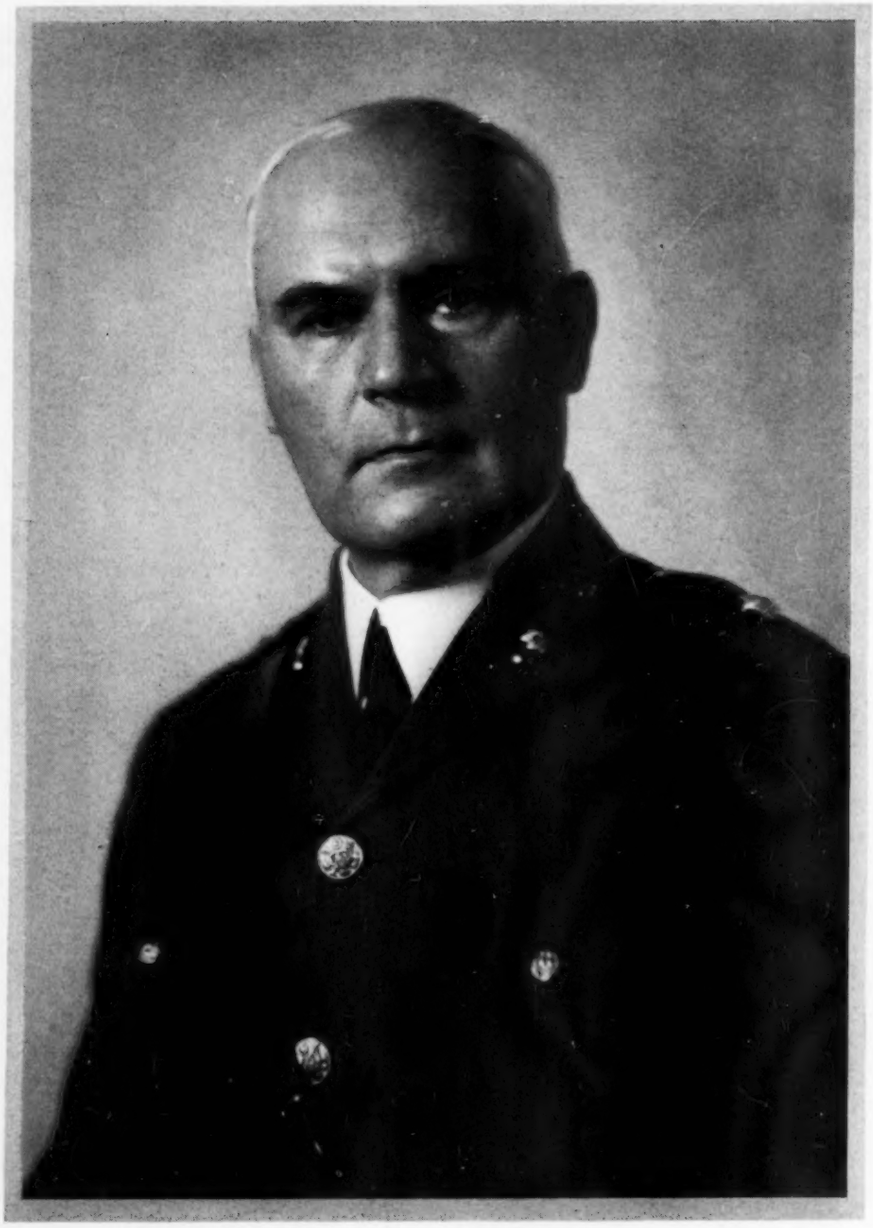
(*Organized February* 24, 1927)

President: TAYLOR ALLDERDICE. *Vice-Presidents:* T. M. GIRDLER, J. FRANK DRAKE. *Directors:* RALPH M. DRAVO, H. A. GIDNEY, J. ROGERS FLANNERY, E. T. WHITER, H. P. DAVIS, FRANK B. BELL. *Treasurer:* G. M. SIXSMITH. *Secretary:* FRED A. MCMAHON, 1014 Diamond Bank Building, Pittsburgh, Pa.

MILWAUKEE

(*Organized September* 26, 1928)

President: W. W. COLEMAN. *Vice-President:* ERIC H. LICHTENBERG. *Directors:* JAMES G. COWLING, HERBERT V. KOHLER, ROGER SHERMAN HOAR. *Secretary-Treasurer:* F. D. HANSEN, 50 Keefe Avenue, Milwaukee, Wis.



Brig. Gen. William H. Tschappat, Ord. Dept., U. S. Army

Assistant to the Chief of Ordnance and Head of the Manufacturing Service of the Ordnance Department

ARMY ORDNANCE

VOL. XI NOVEMBER-DECEMBER, 1930 No. 63

The Control of Industry in War

Principles and Procedure of Our Munitions Supply Program

By Frederick H. Payne*

THERE are two principal phases to modern warfare, each of which must be carried on successfully if the nation is to be victorious in a major conflict. The first is the actual fighting in the theater of operations; the second is the production of the material things necessary to support the fighting forces and furnish necessities to the civilian population. Industrial preparation is the development, in peace, of all preliminary measures that will insure the success of the nation's industrial effort in war. On this task the Office of the Assistant Secretary of War and the Army supply services have been working for ten years. Our aim is two-fold. *First:* We are developing a plan under which the industry of this country may promptly begin the manufacture of the munitions the Army will need initially in a major war. *Second:* We are constructing a comprehensive plan under which the Federal Government may mobilize the country's industrial and economic assets into one coördinated team to assist in the prosecution of the war.

Photo: Pirie MacDonald

Col. Frederick H. Payne, The Assistant Secretary of War, Principal Speaker at the Twelfth Annual Meeting of the Army Ordnance Association.

The essence of the adopted program for assuring the prompt initiation of the production of Army munitions is simply this: The War Department carefully determines the amounts of all items that would be necessary under any given strategic situation. The supply services then determine in detail what industrial establishments will be required to begin producing these items upon the outbreak of war. Most of you are familiar with the system we use to distribute these tentative production schedules to various parts of the country, and with the detailed responsibilities in all their diverse ramifications that each procurement service will have in the event of war.

This plan has been designed to accomplish two different purposes. First, it insures an orderly and efficient distribution of the initial production load to all parts of the country and avoids competitive bidding among purchasing agents; and second, it gives each industrial establishment exact information of the task the Government will expect it to assume upon the beginning of war, and so provides for a prompt initiation of production. In this part of the work, due largely to the valuable assistance rendered by patriotic business men, real progress has been made. If we should face a great emergency tomorrow, we feel reasonably certain that mistakes occasioned in 1917 by our lack of accurate knowledge of military requirements; by the concentration of production tasks in already congested areas; and by unwarranted competition between purchasing agents of the various governmental agencies, would not be repeated.

Intensive study has been made concerning the effect to be expected on the industrial and economic life of our country by the transition from a state of peace to that of war, and by the demands set up by the Army and Navy munitions program. Simply to contract with an industrial establishment for the delivery of a finished item will not be sufficient. An effective control must be exercised over all our industrial assets so that every essential facility may be assured of the necessary raw materials, labor, power and finances. Furthermore, the system employed to secure these

*This is an address delivered by the Assistant Secretary of War to the members of the Army Ordnance Association at the Business and Technical Session of their Twelfth Annual Meeting held in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 8, 1930.—Ed.

results must be so fair and just in its operation that the burdens and sacrifices of war are distributed equitably to all citizens.

In time of peace the commercial and industrial activities of the nation flow from the normal working of the economic law of supply and demand, with a minimum of interference by governmental regulation. In war the Government's attitude toward industry is largely reversed. From one of reliance upon private initiative it becomes one of almost dictatorial control. The demands occasioned by military exigencies become paramount. Some activities must be expanded, others curtailed. Some must be set in entirely new directions, and still others must be regrouped in new relationships. The impulse for all these changes must come from the central government, which alone can determine how the exigency can best be met. This necessarily entails material changes in an administrative machinery that was designed and developed mainly to carry on the vastly different governmental duties of peace.

THIS question of providing an adequate organization to control industry in war is one of the most important and at the same time one of the most difficult that beset us today. The best guide available to us is our experience in the World War. Out of the confusion, extravagance and delays of 1917 there finally emerged in the spring of 1918 the War Industries Board, an organization of American business men established solely for the purpose of putting our industrial effort on a sound business basis. Due to many unusual conditions then existing, the board never succeeded in determining clear-cut solutions to all the problems that arose. The student will find, however, in the history of its activities ample proof that its organization was sound in principle and that the broad scheme under which it operated was effective in procuring desired results. In general the plan that my office has proposed follows that of our War Industries Board of 1917-1918.

Through a centralized industrial organization the Government will control the uses of raw materials, power and money; determine upon prices for commodities and services; and promulgate all necessary regulations. There is no intention of purchasing or otherwise taking possession of the nation's industrial establishments. But they must do their duty to the nation, just as does the soldier on the battlefield—and the organization of which I am speaking will be the President's agent to tell them what that duty is.

The personnel of the central industrial organization must be representative of all phases of our industrial life. Eminent professional men, agriculturists, financiers, representatives of labor, of transportation systems, and of manufacturers, must combine in such an organization to control and direct the use of all our material resources.

Control exercised by such a body will be in many cases indirect, but none the less effective. Public opinion, governmental regulation and, in extreme cases, the power of the Government to commandeer real and personal property will be available to enforce the decisions of this organization. Through the trade associations into which American industry has aligned itself, this governmental organization of business men will be in close touch with changing conditions, and will be able quickly to transmit its wishes and necessities to these corporations and to individuals.

In 1917 Army, Navy and other officials had very little conception of the immediate munition needs of our fighting forces. Contracts for some items were immediately placed far in excess of requirements, while other essential items were initially neglected. Some manufacturing plants were swamped with war orders while others were given none. Government purchasing agents competed among themselves for the output of industrial establishments. As a consequence prices rose rapidly to higher levels and making of large profits by some concerns was unavoidable. Finally, drastic reorganization became necessary.

Contrast that experience with what we visualize will happen in the event of another war. Under the procurement plan, military items will be contracted for only in the amounts deemed necessary, and wasteful use of productive capacity will thus be avoided. The production load will be spread over the entire country and congestion in particular sections will not occur. There will be no competitive bidding between purchasing agents because each has been allotted specific plants with which to deal and thus one great cause for mounting prices will not exist. Finally, since each plant to which has been allotted war work is warned in time of peace of the exact task it will be expected to perform, production of essential munitions can begin with the least possible delay.

Other interesting and most perplexing problems are encountered in attempting to devise a complete plan for the control of our industrial life in war. Among these are determination of priorities in production; preparation of conservation programs; devising plans for the control of finances; and the development of methods for the regulation of prices in war. If time permitted it would be most interesting to discuss some of these in detail, particularly methods for the regulation of prices. The satisfactory solution of this problem is a prerequisite to success in eliminating profiteering and in distributing equitably the burdens of war.

THE brief outline I have given you is little more than a statement of the basic principles upon which the preparatory work in my office is based. A tremendous amount of work remains to be done. Our efforts are directed toward completing the details of the Army procurement plan, and toward preparing the studies and plans that will assist the President in establishing promptly an effective control over national industry.

Certain features of the industrial organization and some of the power it will exercise will have to be specifically authorized by Congress. Drafts of necessary bills are ready to submit to that body the moment a major emergency might be declared.

In the development of the whole industrial plan we have naturally needed, and invariably secured, the coöperation of many prominent civilians. Your Association has continuously evinced an intense interest in industrial preparation, and has contributed in no small measure to the progress so far made. I confidently believe that we will enter the next war, if unfortunately there be one, as an orderly and efficient business concern. This result, which will be contrary to our experience in every war we have ever waged, can be attained only if you and the Nation's other patriotic business men continue to assist us in the great problem involved.

Industrial Relations of Ordnance

The Interdependence of Military and Civilian Effort

By Maj. Gen. Samuel Hof*

IT is indeed fitting that, as we gather for this Twelfth Annual meeting of the Army Ordnance Association, we should pay a tribute of affection and esteem to my able predecessor, General Williams. As you all know, General Williams retired on April first after the fulfillment of forty years active service and the accomplishment of a great task, the task of guiding the munitions effort of this nation through some of the most critical years of its history.

It was my good fortune to have been closely associated with him for many years, and the years we were together constitute for me a pleasant memory. During the World War, when he was appointed to the position of Chief of Ordnance, I was happy because I knew that in him the Department would have a leader in whom it could repose the utmost confidence, and because I knew, too, that under him the Department would meet with intelligence and understanding the problems which confronted it. Many of you gentlemen who are here tonight know General Williams and know of his work. You know with what masterly skill and ease he executed the difficult tasks which were assigned to him. Many of you aided him in his efforts to accomplish these results and I know that I am expressing your feelings, as well as my own, when I say that we cherish the memory of our association with him.

Maj. Gen. Samuel Hof, Chief of Ordnance, U. S. Army, who addressed the Members of the Army Ordnance Association at their Twelfth Annual Meeting.

GENERAL WILLIAMS is now nominally a "retired officer." In any real sense of the term, he can never be a "retired" officer. I know that as long as it is given him to be active in mind and body, his interests will remain aggressively with the Ordnance Department. I shall look forward to the continued benefit of his matured opinions and wise counsel. I trust that many years of useful and active life remain before him both for his own sake and for the sake of the Government he has served so well. As his successor, I realize that the task before me is rendered more difficult because of the standard he set. So, tonight, I ask you who have so loyally aided him for your support, for your coöperation, in order that the work of industrial preparedness, for which the Army Ordnance Association has stood from the beginning, may be carried on.

WHILE for a moment we look back on work well done, we must also forecast the future — note the work still ahead of us and plan the efforts which we must make in order that the swift pace of modern industry shall not pass us by, and that the rapidly developing scenes of the international drama shall not find us inattentive.

From its first year, the Army Ordnance Association has devoted its efforts to the perpetuation and preservation in this country of the art of munitions-making. Seeing the complete stagnation which faced the munitions industry after the Armistice, and patriotically desiring that the American nation should not be without a reasonable measure of industrial preparedness, the Army Ordnance Association has continuously sought to arouse interest in the plans of the Government for the production of its instruments of defense. This centering of interest was especially timely during the post-war years when the Ordnance Department was without the adequate means of dealing directly with industry and when it was supremely important that the industrial lessons of the war, learned at great expense and through bitter experience in a thousand munitions factories, should not be forgotten.

Most fortunate were we in the selection of a leader for our Army Ordnance Association, Mr. Benedict Crowell. As our Director of Munitions during the World War his work had a value impossible of estimation. He occupied a key position at a time when the dictates of personal ambition or the well-intentioned activities of a doctrinaire mind, could equally have spelled disaster for America's

*This is an address delivered by General Hof to the members of the Army Ordnance Association at the Business and Technical session of their Twelfth Annual Meeting held in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 8, 1930.—Ed.

war efforts. He brought to the work courage, loyalty and a clear common sense which were of the utmost value in a very difficult situation.

His work since the war has not been less valuable. We all know what he has done for the Army Ordnance Association, as its President, since the beginning. His counsel has been sought by members of Congress and high officials in the executive departments of the government. His advice has had all the greater weight in that his motives have ever been free from the faintest trace of self-seeking. To Mr. Crowell, the provisions of the law with respect to retirement do not apply. I trust that we may continue to have the benefit of his efforts and of his wisdom for many years to come.

WHEN we organized the system of Ordnance Districts, it became possible to turn over to these permanent and official representatives of the Ordnance Department, certain contacts with American industry which had been so wisely and so patriotically maintained by the Army Ordnance Association. The work thus assumed by the Ordnance District Offices has gone forward successfully. The surveying of industrial capacity for the production of ordnance has progressed to the point where it has only to be kept up-to-date. Most of our important requirements have been tentatively accepted by the plants best fitted for their manufacture. An intimate and friendly contact is being maintained with industry and the need for procurement planning is becoming understood, and its importance is gradually being recognized by the nation.

This work has been of a new character to Army officers and it has been necessary, more or less, to feel our way. But from the experience gained we expect to hasten its progress by more specific instructions for the guidance of our district offices to coördinate all phases of the work without hedging them about with hampering regulations.

While many of the activities formerly the concern of the Army Ordnance Association have been turned over to the districts and can, in fact, be better performed by them than by any other agencies, the Army Ordnance Association is by no means left without important responsibilities. The attention of the nation must be focused on the need for industrial preparedness.

Today we can look back and see clearly how far we fell short of correctly "estimating the situation" prior to 1914. It would be foolish not to recognize the possibility of the whole world again failing properly to measure a future accumulation of scientific, technical, social, economic and political developments, until a resultant lack of stability again hurls the world into another contest. This, of course, is not meant to be a prediction of another world war but a plea for a general appreciation of the need for constant study to prevent war, and alternatively for the maintenance of the position of the United States such that we can make most effective our resources of men and material. We would spare the lives of our soldiers by utilizing the most effective instruments modern science can produce. The Ordnance Department is the interpreter of the fighting forces to the industry.

The Army Ordnance Association exists that the knowledge and experience gleaned in the great World War may not die; that the American nation shall not be unprepared; that there shall be kept alive a knowledge of how to produce economically and quickly its weapons of defense, should a national emergency arise. Thus, the centering of the interest of the nation in ordnance progress, in the related technical methods, and in general matters of industrial preparedness must be accomplished by publicity; by Army Ordnance Association posts and meetings; by journalism; by just such a publication as ARMY ORDNANCE, which the Association has been so successfully publishing during the past eleven years, and which no official War Department activity is in a position to publish. Our congratulations are due the Association on the success of its efforts toward making ARMY ORDNANCE the outstanding publication of its kind in the world.

One important project for increasing the effectiveness of our measures for industrial preparedness is the authorization of so-called "educational orders." This will be discussed by Mr. Trigg, who in behalf of the U. S. Chamber of Commerce has given it much thought. The Ordnance Department is enthusiastically back of this movement.

In closing, I want to express my appreciation to every member of the Army Ordnance Association for the help and coöperation which that Association has given the Ordnance Department. It has ever been an invaluable aid. Your presence here tonight is a visual evidence that your assistance will be given in the future as in the past.

Antiaircraft Machine Guns in Action at the Aberdeen Proving Ground.

Educational Orders for Munitions

Their Far-Reaching Significance to Adequate National Defense

By Ernest T. Trigg*

IN 1917 and 1918 we put to the test our theories and practice of national defense. While the country responded magnificently to the appeal for war service, and the widespread demonstration of patriotism warmed our hearts, the difficulties and delays in getting ourselves organized for action were a bitter experience.

Following the war there was a demand that we take an accounting of this experience and that Congress provide the country with a policy of national defense. Congress responded and that policy is written into the National Defense Act of June 4, 1920.

One of the most important lessons learned in the last war was that the ultimate battlefield is the factory. The National Defense Act recognized this lesson. Wisely it provided that there should be an Assistant Secretary of War, charged with responsibility of continuous planning for the mobilization of the country's industrial and other resources. As this audience knows, there has been set up in the Assistant Secretary's office an industrial planning division, which acts as the central directing and coördinating agency for the several supply branches of the Army in working out plans for industrial preparedness.

As experience has been gained and trained personnel developed, there has been a decided improvement in the planning work of the War Department. It is to be remembered that the most serious of all causes of confusion and delay in the last war was the lack of knowledge of what was wanted. This essential feature of any sound industrial preparedness program is in very much better shape as a result of the large amount of work which has been done and is being carried forward daily through the office of the Assistant Secretary of War.

THERE is one direction, however, in which the business men of this country think our industrial preparedness work can be materially improved. As the matter now stands, the responsible manufacturer on the ordnance program has no experience whatsoever in peace time with the production of munitions. Yet this manufacturer will be called upon in times of emergency to convert his plant from its peacetime commercial production to munitions production. His whole knowledge of the munitions article he will be called upon to manufacture, unless he happens to have some knowledge gained during the past war, is a paper knowledge. He is never given an opportunity to manufacture munitions in peace time.

Plans and specifications for the munitions article to be produced and for the various tools needed to produce it, and for the factory layout for its production, are essential, but they are only the first step. Every manufacturer knows that the successful quantity production of an article requires the adaptation of such plans to factory practice and a familiarity on the part of the men on the job with the numerous processes which enter into its manufacture. The article must be actually manufactured if this experience is to be deposited in the factory.

A great gain will be made in our industrial preparedness work if the responsible industrial concerns, which in the event of another war will be called upon to convert their plants to the production of munitions, are given an opportunity from time to time to manufacture the particular munitions they will be called upon to produce.

Such an arrangement we refer to usually as "educational orders." The designation is a correct one because these orders are educational in every sense of the word. I want to review briefly this matter from the manufacturer's point of view.

I am not speaking from general knowledge in stating that the business men of the country are of the opinion that the industrial preparedness work of the War Department can be improved by granting authority to the Secretary of War to place educational orders with responsible concerns. Rather I am speaking from definite knowledge of the opinion of American business men as expressed through a resolution at the Annual Meeting of the Chamber of Commerce of the United States in May, 1928.

WHAT was the situation which confronted American manufacturers in 1917-18? Let me give you this situation in part, and by using the words of a member of the Chamber's National Defense Committee, who at that time was the production manager of one of the large automobile manufacturing plants in this country.

I am going to quote from the record of a hearing before the House Committee on Military Affairs, at which representative manufacturers with experience with the production of munitions in the past war presented on behalf of the Chamber of Commerce of the United States the case for educational orders. The man to whom I just referred said to the House Committee on Military Affairs:

"In October, 1917, we were approached to make a recuperator. We said, 'What is a recuperator?' We had no idea what it was. It was then explained to us that there are really three parts to a gun, the carriage, the recuperator and the barrel. The carriage carries the recuperator and on the recuperator is placed the gun barrel, and the object of the recuperator is to absorb the shock of the gun after the discharge and return it to its original position to fire, without having destroyed the aim or the range.

"After we got that explanation we said, 'Can we see a sample?' No, they had no samples. Then we were informed that it was complicated, that even the French were confident that were any of these recuperators to be captured by the Germans it would be impossible to duplicate them.

---

*Chairman, Committee on National Defense, United States Chamber of Commerce.

This is an address delivered by Mr. Trigg to the members of the Army Ordnance Association at the Business and Technical Session of their Twelfth Annual Meeting held in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 8, 1930.—Ed.

"The only thing we had to fall back on was the fact that we had been asked to produce them. Obviously, the country needed them and so we took a chance and said we would produce them, purely and absolutely with no knowledge whatsoever, excepting that if they had been made by man before, they ought to be able to be made by man now. That was the way we started to produce, gentlemen. That was all the information we had on which to start to produce one of the vital mechanisms of the war which was needed and for which our men were suffering because of their lack."

I could go on with this gentleman's testimony and recount in detail to you the difficulties which his concern had in getting under way the manufacture of recuperators on a quantity production basis. This company drove ahead, cutting and trying, cutting and trying, until they finally overcame the difficulties. Months and months were wasted because of unfamiliarity with the art of manufacturing a mechanism the country needed them to manufacture in the time of its great stress.

The man to whom I have just referred is Mr. Frederick J. Haynes, of Detroit, Vice Chairman of the National Chamber's National Defense Committee. At the time of the war he was the production manager of Dodge Brothers.

I COULD give you the experiences of many other manufacturers during the past war, all along the same line, cutting and trying, cutting and trying, all because they had no previous experience with the articles they were called upon to produce.

"In June, 1917, General Rice gave us an order for fifty-one 75-mm. antiaircraft gun carriages. The 75-mm. simply referred to the gun. The gun was mounted on an American carriage of American design, with an American designed recuperator and recoil mechanism. The recoil mechanisms which Mr. Haynes referred to yesterday were of the French type and his delay was on the French type of recuperator. The recuperators we made were the American type, spring-recoil recuperators.

"As I say, we were called on to make 51 of those carriages at first and so we made them practically by tool-room methods. We made those carriages by main strength, you might say, and we got them to France. We did not have a chance to make them on a quantity production basis.

"The next contract that General Rice gave us was a contract for four hundred and ten 3-inch antiaircraft gun carriages. We started immediately to tool up for that job. The tooling element that was talked about so much yesterday was a very considerable factor in the manufacture of this carriage. We had to design and make over 4,000 tools, such as jigs and fixtures and gages, in order to handle that job properly. A great many of those tools and fixtures were made with bodies of steel or iron castings. Patterns had to be made for those. The time involved in the engineering work in the design and manufacture of tools needed in a proposition of that kind, we know from experience, would make it impossible for us to make those carriages in a way to accomplish what is expected of us in the present preparedness program.

"In that preparedness program we are expected to make 6 carriages in the seventh month, 10 in the eighth month, 24 in the ninth month, and then 24 in each month thereafter. If we should be called upon now and had no tools, it would be absolutely impossible for us to come through on that program.

"That is what we manufacturers are all worried about. We are asked to assume a certain responsibility in case of war, and we know very well we cannot come through under present conditions. It is absolutely impossible, unless we are given a chance prior to the zero hour to prepare ourselves."

The man whom I have just quoted is Mr. H. H. Pease, President of the New Britain Machine Company. I could give further similar experiences of his company during the last war and also of many other manufacturers.

WHILE the question of munitions production is complicated from the point of view of manufacturing details, it is simple as far as the principle of industrial preparedness is concerned. What is needed is some direct and common sense method to create and maintain in our industrial plants a knowledge and experience with the art of manufacturing specialized munitions. Each plant on the ordnance program should have on hand a complete set of dies, jigs, fixtures and gages, which in time of emergency could be used as a pattern for the rapid production of additional sets. Each such plant should have a personnel who had learned to iron out manufacturing difficulties in peace time and who in time of emergency could serve as a nucleus for the rapid training of additional workers.

What is needed on the legislative side is action on the part of Congress which will give the Secretary of War sufficient discretion, properly safeguarded, to place orders with the requirements of industrial preparedness in mind. A bill to do this has been carefully prepared by the House Committee on Military Affairs in coöoperation with officials of the War Department. It should be enacted into law.

Authorizing the Secretary of War to place educational orders, does not mean that arsenals as centers of munitions manufacture will be interferred with. The War Department will keep at all times a force of trained and skilled workmen at these arsenals to keep alive the art of manufacture and to maintain the arsenals intact ready to receive the full load which has been allocated to them for war production. What the country needs to be prepared industrially are additional units of such manufacture in our commercial plants.

It is hardly necessary for me to add that educational orders are not designed to be, nor will they be, a profitable source of new business to American industry. Far from it. The representative manufacturers who appeared before the House Committee on Military Affairs and the Chamber of Commerce of the United States are not in the slightest interested in such orders as a source of new business or of profit. We are interested in them solely and wholly from the viewpoint of national defense. While of trivial significance commercially, these proposed educational orders are in the judgment of American business men of profound and far-reaching significance from the viewpoint of bringing the defense of our country abreast with the vast complexities of the industrial era in which we live.

The Universal Gun and Mount, T3

New Methods of Transporting and Firing the Weapon

By G. M. Barnes*

IN the May-June, 1930, issue of this Journal (Vol. X, No. 60, page 391), the writer described at some length a new type of weapon for the Field Artillery, which had the following general characteristics: a 75-mm. gun with a maximum range of 15,000 yards, mounted on a universal type of carriage which could be trailed behind a prime mover at high speeds on good roads or across country. The carriage mounted dual wheels with balloon tires, roller bearings at the hubs, and semielliptic spring suspension, and was so designed that the gun could be placed in two firing positions.

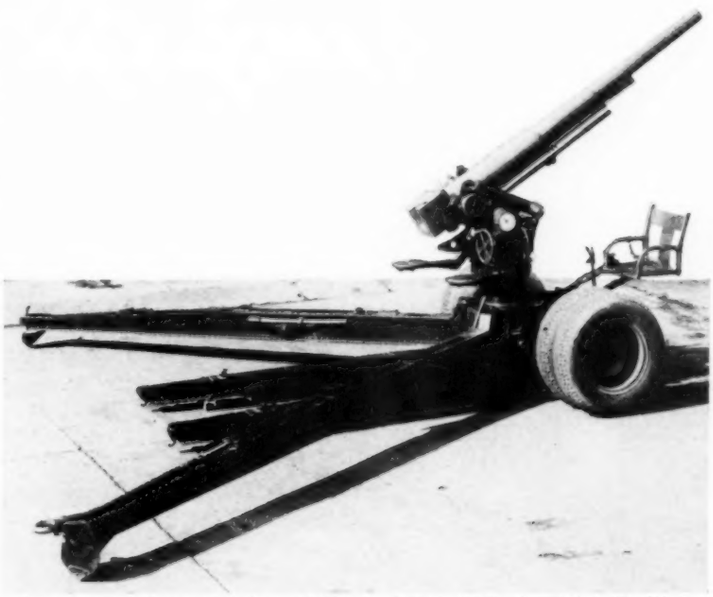


Fig. 1. The 75-mm. Universal Gun and Mount, T3, in Firing Position, 90° Traverse, 45° Elevation.

In the first position, the carriage is similar to the split-trail type, the wheels being in place. Two outriggers are placed under the carriage to protect the springs, axle and roller bearings from the firing load (Fig. 1). The gun can be elevated between 0 degrees and 80 degrees and traversed 90 degrees. In the second firing position, the bogie is removed and the carriage lowered to the ground; the two additional outriggers being in this case attached to the carriage pedestal (Fig. 2). In this position the gun can be traversed 360 degrees and elevated from 0 degrees to 80 degrees. When in either the first or second firing position the gun trunnions can be cross-leveled plus or minus 6 degrees. This feature of cross-leveling not only greatly simplifies the on-carriage fire-control instruments, but insures easy traversing of the gun even though the carriage proper is considerably out of level.

As stated in the above mentioned article, it is also possible to transport this gun and mount on a suitable prime mover by removing the bogie and all outriggers. A small crane built into the truck frame is used for raising and lowering the gun and mount.

It is the purpose of this article to illustrate and explain this last mentioned method of transporting the gun and

*Chief, Design Section, Watertown Arsenal, Watertown, Mass. Major, Ordnance Department, U. S. Army.

Fig. 2. The 75-mm. Universal Gun Mount, T3, in Firing Position, 360° Traverse, 80° Elevation.

carriage in more detail and to add a description of an additional method of firing this same gun, which has been devised since the first article was written.

Fig. 3 shows the 75-mm. T3 Universal Gun and Mount carried on a 6-wheel truck, of a commercial type, which was selected as a prime mover for this type of gun carriage. This truck, which weighs 7,500 lbs. without the gun or crane, has a powerful commercial truck engine which will develop about 85 h. p. In a 6-wheel truck of this type, both of the rear axles are driven. Dual bus balloon tires are mounted on all three axles so that when going across country the load is supported on twelve pneumatic tires. In this way the pressure per square inch on the ground is very low, about 5 lbs. per square inch, insuring great cross-country mobility. The transmission provides eight speeds, giving sufficient reduction to insure hill-climbing ability. Grades as steep as 35 degrees can be negotiated with the gun and carriage in place on the truck. On level ground the truck carrying the gun and mount can travel at speeds as great as 45 miles per hour. A small crane made of duralumin, for lightness, has been built into the end of the truck. This has sufficient capacity for lifting the gun and mount from the truck and lowering it on to the ground, or vice-versa. A special mechanism is also provided for securely clamping the mount to the truck when traveling. This mechanism is, however, so designed that the gun mount can be quickly unlocked from the truck frame and lifted or lowered by the crane. It is thus possible to remove the gun mount from the truck and place it on the ground in the firing position illustrated in Figs. 2 and 4, in which position the gun can be fired throughout 360 degrees traverse and at any elevation between 0 degrees and 80 degrees. By using the crane, the gun and mount can also be raised from the firing position and returned to this position on the truck.

In this connection it might be stated that the parts for holding the mount to the truck and the crane are secured to the truck frame by bolts. In case of accident to the truck motor or any other part of the truck, these parts could be removed and placed on another similar truck, the main restriction being that the truck frames have similar dimensions. A battery equipped with guns and mounts of this type would have trucks for carrying ammunition, supplies and fire-control instruments. The frames of these trucks could all be built to the same dimensions in order that any truck could be used for transporting the gun and mount by bolting the above mentioned parts to the truck frame.

Fig. 3. 75-mm. Gun and Carriage, T3, on Truck Mount.

THE new feature, which has been added to this all-purpose weapon, is that of firing the gun directly from the truck as shown in Figs. 5 and 6. The four outriggers pertaining to this mount are, in this case, attached to the truck body. Four screw jacks bolted to the truck frame are also provided to protect the truck spring suspension and tires from the firing load. These jacks, which carry floats at the lower ends, should be screwed down tight against the ground in order to transfer the weight of the truck and mount from the truck wheels to the jack floats. The design permits the gun to be fired from the truck throughout 360 degrees of the traverse and at all elevations between 0 degrees and 80 degrees. The crane can be dismantled and removed from the truck in about five minutes so as not to interfere with the gun when traversed in a position parallel to the truck body.

To recapitulate, the 75-mm. T3 Mount can be transported as follows: (a) Trailed on its own wheels behind a prime mover, and (b) carried on the prime mover, the bogie in this case being discarded altogether, or, if desired, trailed behind the prime mover.

It can be placed in the following firing positions: (a) With wheels in place, trails opened like a split-trail car-

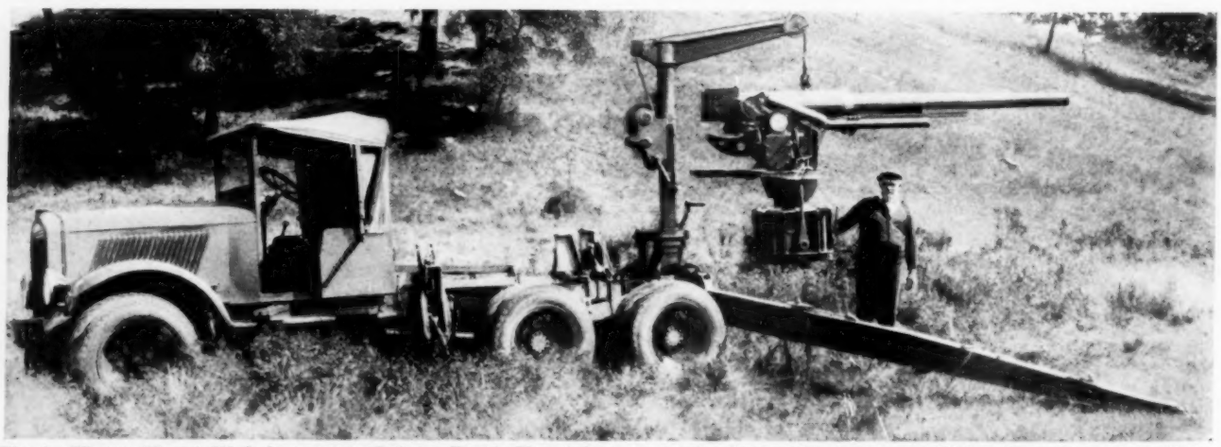


Fig. 4. 75-mm. Mount, T3, being removed from Truck Mount by means of a Crane, Preparatory to Firing from Ground Position.

The All-Purpose Gun and Mount T3 in Action

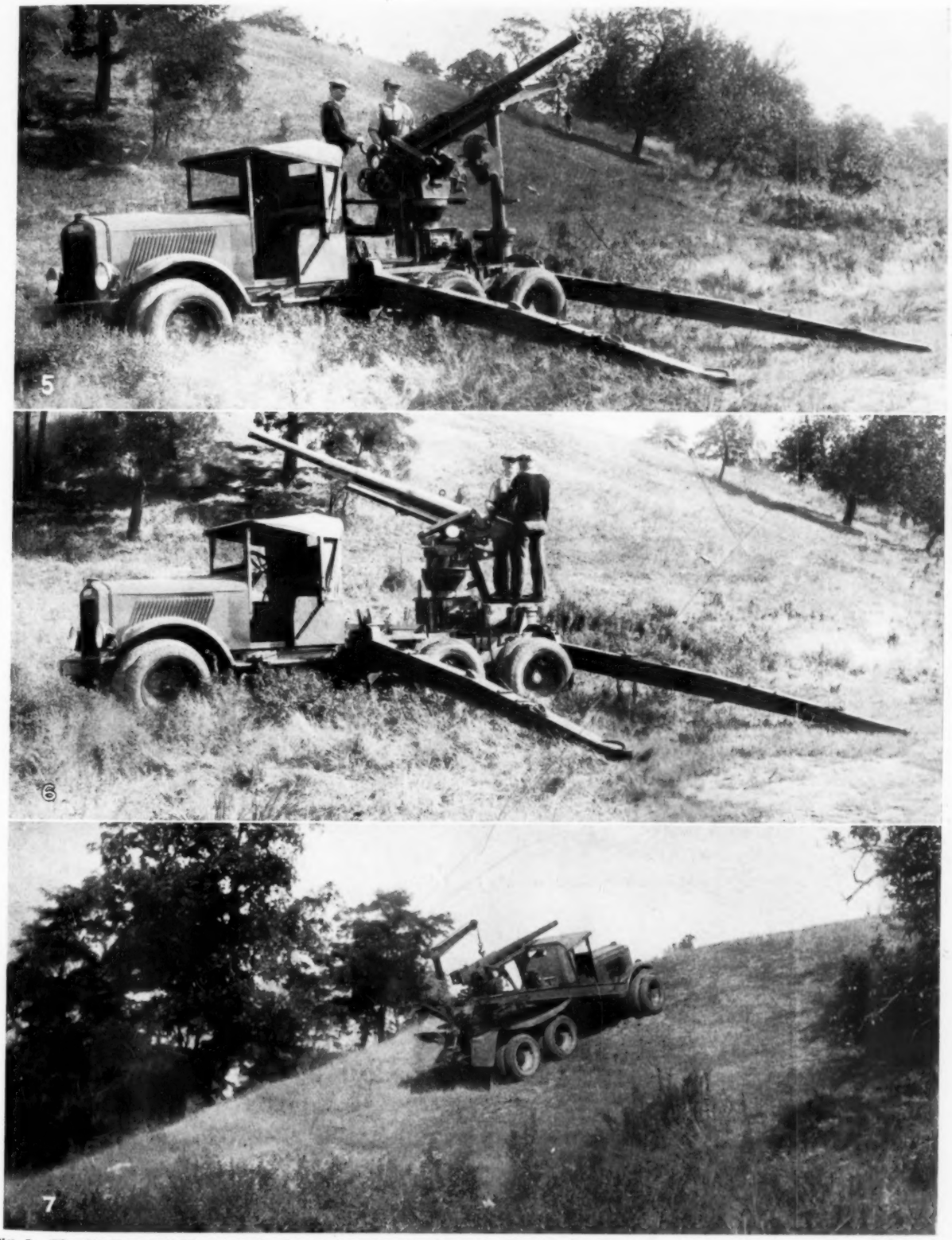


Fig. 5. The T3 Gun and Mount ready for Firing Directly from the Truck with Crane Removed. Fig. 6. Another view of the Mount in Firing Position. Fig. 7. The T3 Mount on Truck Climbing a 30° Slope.

The T3 Truck Mount with Gun Carriage in Tow.

riage (Fig. 1). In this position the gun can be traversed 90 degrees and elevated between 0 and 80 degrees and cross-leveled plus or minus 6 degrees. (b) The bogie removed and the mount lowered to the ground using the two outriggers as levers, and later attaching them to the pedestal as outriggers. In this position the gun can be traversed throughout 360 degrees and elevated between 0 degrees and 80 degrees and cross-leveled plus or minus 6 degrees (Fig. 2). (c) The gun and mount can be carried on the truck and removed from the truck using a small crane and placed in the same firing position as described in (b) above. (Figs. 3 and 4.) (d) The gun can be fired directly from the truck using the same outriggers, which are in this case attached to the truck to give it the necessary stability. In this position the gun can be traversed 360 degrees and elevated from 0 degrees to plus 80 degrees, cross-leveling plus or minus 6 degrees. (Figs. 5 and 6.)

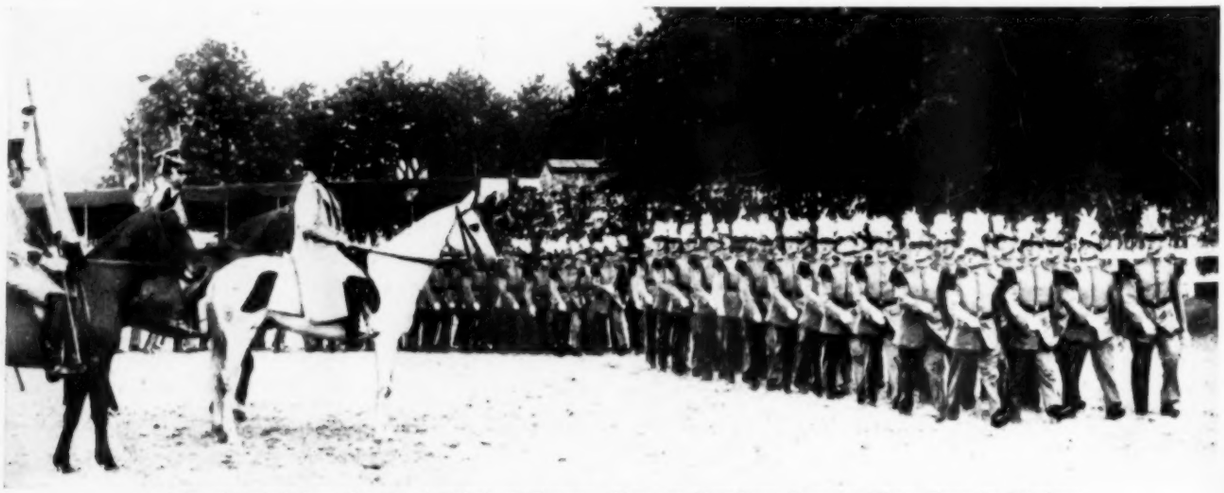
In short, the Field Artillery, for the first time in history, now has (for test) a high-power 75-mm. field gun which can travel under its own power, 500 miles on good roads, in a single day.[1] It can also travel over dirt roads, or where there are no roads, at speeds from 1/2 and 30 miles per hour depending upon the terrain. When the light steel tracks, which are carried on the truck and which can be applied in about five minutes, are placed between the rear wheels of the 6-wheel prime mover, the gun can be transported over ground as soft as that which could be negotiated by a tractor having sufficient power to pull the 75-mm. field gun.

In all of the four firing positions the gun is completely stable at all angles of elevation and traverse. There is no tendency of the gun carriage to lift from the ground and the gun is not thrown out of level by the firing. The elevating and traversing mechanisms, which have been applied to this carriage, are designed so as to permit the gun to be continuously trained with great accuracy upon swiftly moving targets. In short, the weapon, in addition to its use for strictly divisional artillery missions, is also an ideal antitank and antiaircraft weapon.

I have outlined above the outstanding capabilities of this new divisional weapon. In the previous article, the writer discussed at some length the fire-control apparatus which must be used with this new weapon, to realize its capability as an antitank and antiaircraft gun.

Will the Officers of the Field Artillery now work out the tactical uses to which this new high-powered mobile weapon can be put? Would they not like to have artillery with these characteristics in their battery, regiment or division?

1EDITOR'S NOTE: This truck mount left the Watertown Arsenal, Watertown, Mass., at 4 A. M., October 7, 1930, and arrived at the Aberdeen Proving Ground, Md., at 8 P. M. the same day, a distance of 425 miles in 16 hours elapsed time, going through New York, Philadelphia and other cities en route.



Cadets at Saint-Cyr, the West Point of France, Observe Napoleon Day as They Pass in Review Before an Impersonation of the Little Corporal.

The Development of Army Ordnance

Investigations and Results in the Improvement of Weapons

By Brig. Gen. William H. Tschappat*

IN presenting to you the developments of ordnance matériel which we have accomplished lately, I am confident that I need not consume any time in reiterating our problems or outlining our methods of work. You are all familiar, more or less, with the attempts of the Department during the last ten years to produce ordnance equipment for our army equal to or superior to any ordnance that exists elsewhere in the world. I shall accordingly proceed at once to describe some of the matériel which we have succeeded in standardizing and to tell you something of the investigations which we have made toward the improvement of this standard ordnance as far as the Department has been able to see further advances. Where convenient I will take the opportunity to compare the ordnance which was used by our Army during the World War.

You will recall that a board, known as the Caliber Board, was organized just after the World War, and after visiting all of the foreign countries and noting the latest type of ordnance that they had produced during the last years of the war, as well as getting the opinions of their principal foreign technical leaders, this board laid down the requirements of ideal weapons to perform the missions to which they would be assigned. It also indicated what were considered to be the most practical solutions of the problems of that date.

The Ordnance Department, working with the Ordnance Committee of the Technical Staff, on which committee are representatives of all of the using services, has gradually approached the ideal solutions suggested by the Caliber Board and in many cases has set up still newer ideals for the inspiration of our designers. In some cases, due to the advances in science and engineering in the last ten years, we have even surpassed the ideals set up by the Caliber Board.

EVER since the year 1900 and intensively since the World War the Ordnance Department has continued its efforts to produce a semiautomatic shoulder rifle suitable for issue to the service to improve the rate of fire of the rifleman The best rifle designers of the world have been working on this problem for several decades and have produced some fairly successful hunting rifles which are semiautomatic, but a really satisfactory military rifle has never been adopted by any army. Mr. Pedersen, working at the Springfield Armory under contract with the Ordnance Department, produced one type of military semiautomatic shoulder rifle in caliber .276 which has given considerable satisfaction. Twenty of these rifles were made at Springfield Armory and were tried out by the Infantry and Cavalry Boards with very satisfactory results. At the same time Mr. Garand, working at the Springfield Armory, produced twenty caliber .30 rifles which operated by the principle of the blow-back primer. These were fairly successful but not entirely satisfactory. Later on, Mr. Garand produced a caliber .276 rifle on the gas-operated principle which gave considerable satisfaction.

Last year a competitive test, supervised by a War Department Board, was held in Washington and at the Aberdeen Proving Ground of semiautomatic rifles from all sources throughout the world. At this test there were presented nine types of semiautomatic shoulder rifles, most of them being long receiver, clumsy types; and in the difficult test given them all failed in many particulars. The Pedersen and Garand types gave the best results and were passed on by the board as two more or less satisfactory military rifles in this caliber. As twenty Pedersen rifles had already been tested in .276 caliber, it was decided to build twenty Garand rifles in the .276 caliber for service test. These rifles are now being completed. In view of the fact that considerable progress has been made in the design of rifles from the time the caliber .276 was adopted, the board recommended that Mr. Garand construct a caliber .30 rifle along the lines of these .276 rifles, which should not weigh more than the present Springfield rifle. The caliber .30 rifle constructed by Mr. Garard has been completed and will be tested by the Ordnance Department in November of this year. It is hoped within another year to arrive at a semiautomatic shoulder rifle which will meet all the requirements of the using services.

THE Browning water-cooled machine gun, caliber .30, remains from the World War as the standard machine gun of the Army. The only change since the World War has been an improved rear sight.

At the present time the machine gun tripod of the World War is inadequate to meet the tactical demands imposed upon machine gun troops because ground troops are likely to be attacked by low flying aircraft. To meet this menace and as a result of experiments and suggestions by the Infantry, the wheeled machine gun mount MI has been designed. This mount carries the ground tripod and can be used either as a ground tripod mount or as an antiaircraft mount. Machine gun carts will be abandoned when these new mounts come into general use. An adapter has been designed for enabling the machine gun to be mounted on the tripod in such a way that high-angle fire can easily be executed.

The Browning aircraft machine gun, caliber .30 M2, is now in production. It is very much lighter than the previous Browning aircraft machine gun, is arranged so that it can be quickly converted for either right or left-hand feed and permits a balanced installation about the center of gravity of the airplane for both synchronized guns and wing mounts. Important changes in the firing mechanisms have been made. The trunnions and the mounting arrangements have been especially designed for aircraft use so the line of thrust is on the center line of the gun. The gun can

*Assistant to the Chief of Ordnance and Chief of the Manufacturing Service, Ordnance Department, U. S. Army. This is an address by General Tschappat to the members of the Army Ordnance Association at the Business and Technical Session of their Twelfth Annual Meeting in the Auditorium of the U. S. Chamber of Commerce, Washington, D. C., October 8, 1930.

be constructed to fire at the rate of 1,500 rounds per minute but usually it fires at a lower rate.

The caliber .50 gun is being developed for use against aircraft in a four-gun single mounting, to increase the volume of directed fire and to give greater mobility with mobile troops. The mount is designed as a part of a special six-wheel-drive truck. Its leveling devices are operated from the driver's seat and a director is used in conjunction with a stereoscopic range finder for mechanically controlling the fire. Using tracer ammunition the gunner may also observe the fire through his stereoscopic range finder and make visual corrections. Continuous belts of 1000 or more rounds are used with a special feeding device operating by the recoil of the guns.

The two-gun multiple mount is also designed for protecting troops on the march against ground and aircraft hostile fire, using the same belts and feeding mechanisms as the four-gun mount. The fire of this mount is directed by the gunner who controls the elevation and traverse by gears and fires the guns by special triggers attached to foot pedals. Through the stereoscopic range finder he determines the position of the trace with reference to the target and makes the necessary corrections himself. This unit is mounted on a track of standard design and can be dismounted for use in fixed or semifixed positions.

THE various types of ammunition developed since the 1906 ammunition constitute the standards of the World War. You will recall that the 1906 ammunition fired a 150-grain flat based bullet with a muzzle velocity of 2,700 feet per second to a range of 3,400 yards. During and after the World War an intensive program of development was undertaken to increase the range and accuracy of machine gun fire. This resulted in the production and standardization of a new type of bullet weighing 172 grains and having a tapered or boat-tailed base. The new bullet is fired at a muzzle velocity of 2,650 feet per second and has a range of 5,500 yards with a lower powder pressure than was required to give the old bullet 3,400 yards. Its use in the shoulder rifle greatly increased the accuracy at moderate ranges. Furthermore, it has a jacket of gilding metal which reduces the objectionable metal fouling in the rifle barrel. The ammunition is now made as armor-piercing ammunition, as standard ball ammunition and tracer ammunition. The armor-piercing bullet weighs 168 grains and has a hardened steel core. At 260 feet this bullet will pierce a chrome alloy steel plate six-tenths of an inch thick. The tracer ammunition has a bullet with a chemical composition pressed into the base which burns with a brilliant red flame while the bullet is in flight. The caliber .30 tracer is visible in daylight for about 1,200 yards, the caliber .50 for about 2,000 yards. The caliber .50 bullet weighing 750 grains has a range of 7,500 yards.

The caliber .50 tracer ammunition, besides giving a visible trace in firing at aircraft, acts as a very effective incendiary for use against balloons and other aircraft.

THE French type of 37-mm. gun was used during the World War. The Infantry is still equipped with it. It fires a 1¼-lb. shell to a maximum range of 3,700 yards. Its total load is 231 pounds. It can be fired on a tripod mount and in this position weighs 180 pounds. Pack equipment has been designed also for its transport on animals.

The 37-mm. Infantry gun M2 on the new carriage M1 fires a 1.45-lb. shell with a muzzle velocity of 1,850 feet per second and penetrates one inch armor plate at 500 yards. Its maximum range is approximately 5,000 yards and it has a traverse of 67°, permitting its use as an antitank weapon. Although it is normally drawn on its two wheels limbered to a cart, it can be divided into four loads for hand transportation.

The single firing, low velocity 37-mm. guns were unable to cope with airplanes and it became necessary to develop an automatic firing 37-mm. gun with higher muzzle velocity. This work has been done by the Colt's Patent Fire Arms Manufacturing Company, in conjunction with the Ordnance Department, and we now have three of these guns suitable for antiaircraft fire. A new mount of the trailer type has been developed. Particular note should be made of the use made of welding in its construction. A great saving in cost of manufacture and in weight has been made in thus producing this new type automatic high velocity antiaircraft gun mount.

The 3-inch Stokes trench mortar used during the World War is still in service. It hurls a projectile weighing 12 pounds end over end to a maximum range of 750 yards. The old bipod construction permits firings at elevations from 40° to 75°. It weighs approximately 110 pounds. This Stokes equipment has been greatly improved by the Stokes Brandt Mortar Company of France by using a better tube, a more accurate bipod device and a vaned projectile which prevents tumbling in flight. One of these mortars was purchased by the Ordnance Department and tried out at the Proving Ground and at Fort Benning with considerable success. The patent rights for use of the vaned projectile are being procured by the United States.

To meet the demands for mobility, greater safety and larger projectile, the 75-mm. Infantry mortar M1 was developed, first as a rifled mortar and later as a smooth-bore weapon. It is now provided with a vaned projectile of the Stokes Brandt type weighing approximately 10.5 pounds, which flies true in its trajectory and attains a maximum range of about 2,000 yards. This weapon is capable of being broken up into four loads for hand transportation where it can not be dragged on its wheels.

The 2.95-inch mountain gun (V. M.) was obtained for use by our troops during the Philippine Insurrection, and the service has been equipped with it ever since. It fires a shell weighing 11.85 pounds or shrapnel weighing 16 pounds. The maximum range at elevations permitted by the carriage is 4,400 yards. Traverse is accomplished by moving the trail. Its weight in firing position is 830 pounds and it is broken up into four loads for pack transportation. It is a very rugged weapon but has neither the field of fire nor the stability necessary for modern artillery.

After three years of development work, a satisfactory model of pack howitzer (75-mm.) was built by the Ordnance Department and tested by the Field Artillery. Four units have been constructed to date, and fifteen more are nearing completion. In the spring of 1927 one battery of the Fourth Field Artillery was equipped with this weapon, which was thoroughly tested in an extensive practice march, which included the maneuvers of the Second Division at Camp Stanley, Texas. The performance of the matériel was satisfactory to the using service, which requested its

designation as standard for manufacture. This weapon is intended to take the place of the 2.95-inch mountain gun with which the service is equipped at present. It fires a 15-lb. shell a maximum range of 9,000 yards. The weight of the matériel in firing position is 1,305 pounds. It is divisible into six loads for pack transportation, no load being heavier than 225 pounds, or it may be drawn by one animal, or two animals in tandem, upon its own wheels.

OUR artillery has been equipped with the 75-mm. gun, M1897 (French) since 1917. It is a stable, accurate, rapid-fire weapon; but the low elevation permitted by the carriage (19°) and the narrow traverse (6°) place a considerable handicap upon obtaining with it a reasonably large field of fire. The maximum range permitted by the carriage is 9,200 yards with a 13.5-lb. projectile. Its total weight in firing position is 2,650 pounds.

Based upon the recommendations of the Caliber Board there has been developed, and adopted as standard for manufacture, a 75-mm. gun and carriage designated as M1. This weapon fires a 15-lb. projectile to a maximum range of 15,000 yards. The carriage permits of 45° elevation and, being of the split-trail type, a total traverse of 45° is possible. Its weight in firing position is approximately 3,200 pounds. An extensive study was made of the value of the box-trail carriage as compared with the split-trail carriage; the great field of fire of the latter was responsible for the decision in its favor. A tremendous advantage is gained by being able to command a wide front without shifting the trail.

Much thought and effort have been expended upon the design of this weapon from the production point of view, and it is confidently expected that it can be manufactured with very little difficulty.

Early in 1929, work was begun on the design and manufacture of a field gun which would have high road speed possibilities, high angle fire (up to 80 degrees), all around fire, and be able to utilize the latest systems of fire control against aircraft, tanks and other high speed targets.

Two new types of field gun carriage which meet these requirements have recently been completed at Watertown Arsenal. One is called the 75-mm. gun mount T2, the other, the 75-mm. gun mount T3. The gun and recoil systems used on these mounts are from the 75-mm. gun, Model 1923E, having a muzzle velocity of 2,175 feet per second, giving a range of 15,000 yards with a 15-lb. projectile.

The new divisional artillery weapon, known as the T3, in addition to its normal employment against stationary or slow-moving ground targets, is constructed so as to be able to use the latest fire-control system employed by antiaircraft artillery; thus the gun can be kept constantly pointed at the predicted position of a high speed target, such as an airplane or armored car.

The weight of the gun and carriage in the firing position is 5,800 pounds, or nearly twice the weight of the French 75-mm. However, it has dual heavy duty balloon tires which give a ground contact of 832 square inches with a ground pressure of 6.9 pounds per square inch, as compared with a ground contact of 194 square inches and 13.7 pounds pressure for the French 75-mm. To make the gun as light as possible, advantage has been taken of the latest developments in high grade steels, the new welding process developed at Watertown Arsenal and the use, wherever possible, of aluminum alloys having one-third the weight of steel. The T3 carriage has antifriction bearings and spring suspension, which enable it to be towed at high road speeds.

All around fire necessitates a pedestal mount and four trails to take up the force of recoil from firing in any direction. Thus, this gun is provided with a split trail and two other supplementary trails, which can be affixed for all-around firing. Without removing its wheels, axle and springs, this gun can be fired somewhat like an ordinary field piece by opening up its split trail and taking the load off the wheels and springs with jacks; in this arrangement it has 90° traverse. For all-around fire, however, the wheels are removed, the supplementary trails affixed and the pedestal mount lowered to the ground. The gun can be put in battery from the traveling position for 90° traverse in one minute, and for 360° traverse in four minutes.

A truck mount to carry this gun and from which the gun may be fired has been completed recently and tried at Aberdeen Proving Ground. This truck mount, together with the trailer mount with the interchangeable gun carriage, will be turned over shortly to the Field Artillery Board for test at Fort Bragg. This all purpose gun is, of course, purely in the experimental stage and it would not at this stage be put in production in any emergency. It will be thoroughly tested by the using services and if found to meet military requirements, which are rapidly changing in this age of transition to mechanical transport, it will doubtless be adopted in some modified form.

Various attempts have been made to establish an all-purpose gun as laid down by the Caliber Board. With the T3 all-purpose mount on six-wheel truck, the crane may be removed by hand for allowing 360° fire. The 75-mm. gun, Model 1925, is used on these mounts. A more suitable gun design may be desirable when the most acceptable type of mount is selected. The T3 mount is equipped with receivers. With a standard director and height finder attached it is capable of executing fully controlled antiaircraft fire.

THE United States never has been equipped with a modern division howitzer. The 155-mm. howitzer was used for this purpose during the World War. Its mobility, however, is too slow to permit its efficient employment with the division under conditions of mobile warfare.

The 105-mm. howitzer M2 and the carriage M1 have been standardized. This weapon fires a 33-lb. shell a maximum range of about 12,000 yards. The carriage permits of 65° elevation and 45° traverse; and the total weight is approximately 3,745 pounds in firing position or 545 pounds heavier than the new 75-mm. gun. It is of the split-trail type. As in the division gun matériel, it has been decided that this split-trail carriage is a more suitable type. Ten howitzers with their carriages are nearing completion for issue to the Field Artillery.

It is felt that the 105-mm. howitzer as a companion piece to the 75-mm. gun in the division is a most valuable weapon and capable of possibilities which only extensive use by the service can develop.

New studies indicate that it may be possible to substitute a gun-howitzer, caliber 90 or 95-mm. for the 75-mm. gun and the 105-mm. howitzer with suitable ammunition for all problems assigned to these two calibers. Our next year's

development will demonstrate whether this idea can be made practicable.

The Department is engaged at the present time in the design of a number of different types of ammunition-carrying vehicles. The transport of ammunition for light field artillery presents a very difficult problem. For the weapons which have been manufactured and delivered to the service for test, ammunition vehicles of conventional designs have been constructed. It is with the purpose of development of the best in such auxiliary vehicles that the above-mentioned project is being undertaken.

TO accomplish the mission of a corps gun, the 4.7-inch gun matériel, Model 1921, was designed and built. The gun fires a projectile weighing 50 pounds a maximum range of 20,000 yards. The carriage permits a maximum elevation of 45° and a total traverse of 60°, and is of the split-trail type. The total weight of the unit in traveling position with limber is approximately 12,000 pounds. This weapon has been built by the Ordnance Department and tested by the Field Artillery with generally satisfactory results. It is expected that a few modifications will be incorporated in this unit, after which it will again be subjected to service tests. At present all work on it is suspended.

The corps howitzer, as the 155-mm. howitzer is sometimes called, is intended for a companion piece to the 4.7-inch gun. It fires a 95-lb. projectile a maximum range of 16,390 yards. The carriage permits an elevation of 65°, and is of the split-trail type. The total weight in firing position is approximately 14,000 pounds. Two pilots, based upon a pilot designed and built in 1920, have been completed and are being subjected to test.

The two corps weapons were originally intended to be mounted interchangeably upon the same carriage, which made of the carriage a dual purpose machine. Further investigation and development seemed to show that this is not altogether sound. More economical use of the weight can be exercised in designing the carriage for the particular purpose for which it is intended and, therefore, the interchangeable carriage for this type of weapon has been abandoned. A decision which aided materially in arriving at this conclusion was that which stated that the maximum elevation of guns should be 45° and that of howitzers should be 65°. This clearly defines the status of the gun which, with its high velocity, is intended to reach out to great ranges, and also of the howitzer which with its large projectile is intended to search out territory which it is permitted to do by its curved trajectory, using zone fire.

THE 155-mm. gun (Filloux) has been standard equipment since the war and was used extensively by the French and American troops in the war. It is an excellent weapon of considerable power. It fires a 95-lb. projectile a maximum range of 17,460 yards. The carriage permits an elevation of 35° and a total traverse of 60°. Its total weight in firing position is approximately 26,000 pounds. In our service it is hauled by a 10-ton tractor. Its wide traverse is a particularly desirable feature permitting rapid changes of target without the necessity of moving the carriage. Artillery development, however, has indicated that 35° elevation with a weapon of this type is too limited to fulfill all missions, and also has shown quite definitely that greater range is desired of a gun of this caliber.

The British 8-inch howitzer was used during the World War, and it is still available for issue to the service in case of an emergency. It fires a 200-lb. projectile a maximum of 12,360 yards. The carriage provides 45° elevation and 8° traverse. The firing platform provided for use with this howitzer allows a traverse of 52°. The matériel weighs about 21,000 pounds in firing position.

The Caliber Board calls for a gun of about 155-mm. caliber with an elevation from 0 to 65° and all-around fire, maximum range of 25,000 yards, projectile weighing not over 100 pounds, which projectile would be interchangeable with that provided for the howitzer mounted on medium field carriage. It was recommended that on this same carriage with this 155-mm. gun should be mounted an 8-inch howitzer with the same elevation and traverse. The projectile of the howitzer should weigh not over 240 pounds; the maximum range of the howitzer should be about 18,000 yards. The redesign of the heavy matériel for both 155-mm. gun and 8-inch howitzer based upon the results of the tests of early individual models indicates that a satisfactory combination can be produced. The new 155-mm.-8-inch howitzer carriage T2 is intended to supersede the 8-inch howitzer carriage.

At the present stage of ordnance development, it appears that the 14-inch gun railway mount M1920 is the largest mobile mount practicable. The clearance and weight limitations of railroads would not permit a larger or heavier mount. The 14-inch, 50 caliber gun fires a projectile weighing 1,560 pounds a maximum range of approximately 45,000 yards. The carriage permits of 50° elevation and 360° traverse on the emplacement; on the track 7° traverse is possible.

The carriage is so constructed that the gun may be fired from a temporary emplacement on the track, prepared with steel beams to support the weight on the road bed, and outriggers to provide stability. In such an emplacement the trucks are relieved of firing stresses, but the gun can be fired only in the general direction of the track. The mount can also be run on to a prepared emplacement, which it is anticipated will be the usual method of employing this piece. On such an emplacement the gun has all-around fire. The virtue in a weapon of this type is that with a number of prepared emplacements along the seacoast, advantage can be taken of its mobility to provide ample defense with relatively few guns. A number of these mounts have been completed.

The 12-inch barbette carriage, Model 1917, is one of the most outstanding developments of seacoast artillery in the pre-war period. It fires a 975-lb. armor-piercing projectile a range of about 30,000 yards. Although it has been superseded to a great extent by the 16-inch gun mounted on a barbette carriage, it will remain for a great many years a weapon capable of performing all its missions.

Four 16-inch howitzers and carriages, Model 1920, have been completed and are emplaced. This howitzer fires a projectile of 2,100 pounds approximately 15 miles. Its carriage permits of 65° elevation and 360° traverse. Although intended for mounting in permanent emplacements for seacoast defense, it appears that this weapon can be mounted on the 14-inch railway mount. This has not been proved to date by proper test, but it is expected that such a test will be carried out at some future date. (*To be continued in the January-February, 1931, issue of this Journal.*)

Smokeless Powder Grains

Causes and Characteristics of Structural Variations

By A. J. Phillips*

THE actual variations in the structure of smokeless powder grains, which may be observed by a microscopic examination of thin sections, are not as important as the connection which exists between the observed structures and the various properties of the powder, such as rate of drying, shrinkage, rate of burning, pressure and velocity uniformity, and stability.

Fig. 1. Die and Pin-Plate Assembly.

The connection between structure and the above characteristics is sometimes rather vague and nebulous because of the large number of variables always involved. However it is possible to establish a connection by taking these variables, one at a time, and studying their characteristics.

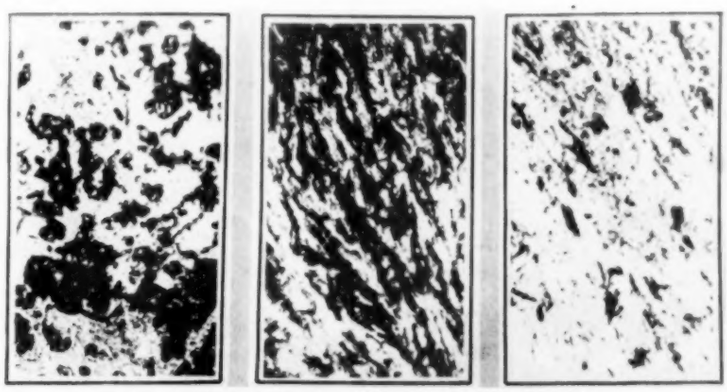


Fig. 2. Initial Block; After Screening; Final Block.

As an illustration of the connection between structure and some property of the powder, variations in the web thickness of powder grains affect the accuracy with which a projectile finds a target, variations in shrinkage affect the web thickness, variations in the viscosity of the pyrocotton employed affect the shrinkage and variations in viscosity are liable to be reflected in the internal structure of the grains.

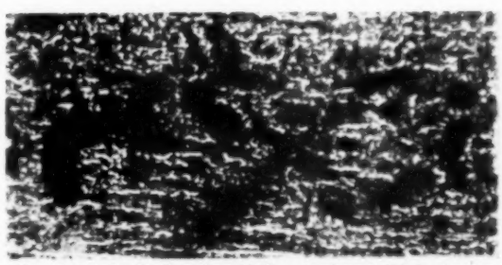


Fig. 3. Low Refractive Index, Solvent Rich Areas in Grain Section.

AN important factor in connection with shrinkage is the viscosity of the pyrocotton employed. If the material on dispersion in a solvent gives a thick, viscous mass, as opposed to a thin mobile liquid with another pyrocotton, using the same amount of solvent, then the characteristics of the grains from those high and low viscosity pyrocottons will be different and this difference will show on examination of thin sections with a microscope.

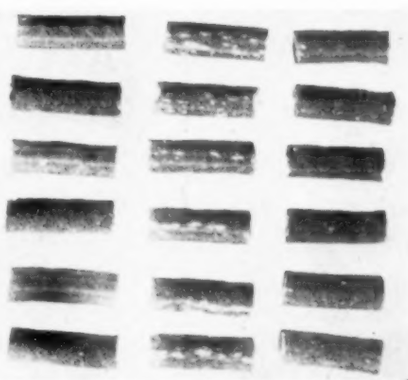


Fig. 4. Variable Surface Conditions in Grains from the Same Composition.

When a block of gelatinized nitrocellulose is forced through the graining die shown in Fig. 1, it emerges from the holes in the pin plate die like strings of vermicelli. The graining pressure welds these strings around the pins in the pin plate, as they move forward, thus forming the perforations in the grain. According to the viscosity of the mass, the weld may be perfect or imperfect, and it will show when an examination is made of a cross section of the grain.

The presence of undispersed material in itself is not objectionable in a powder grain, since gun-cotton, which is not dispersed by ether-alcohol, is sometimes added to pyrocotton to increase the potential of the powder. It is the distribution of the undispersed material which affects the rate of drying and also may exert an undesirable effect upon the normal progressivity of the powder.

The process of blocking and screening the plastic dough, before being extruded in the graining press, has been followed microscopically and it has been found that the pyro, which gelatinizes readily, is forced into and through the particles of ungelatinized gun cotton. In addition, the mechanical working in the blocking and screening operations causes a marked reduction in the size of the undispersed aggregates. Fig. 2 shows this reduction in size of aggregates, the dark areas being undispersed guncotton. If the large undispersed aggregates are not reduced in size, it becomes difficult to dry the powder. The well gelatinized and dispersed areas lose their solvent

*Associate Chemist, Research Laboratories, Picatinny Arsenal, Dover, N. J.

readily and dry out to a hard dense impermeable mass. The wet, soggy areas of undispersed guncotton, impregnated with gelatinized material, dry at a slower rate because there is relatively less surface exposed for loss of solvent. In addition, the solvent which would otherwise be lost cannot readily penetrate the surrounding dense material, the grains hold their volatile content and prolonged drying becomes necessary to reach a desired volatile content. Fig. 3 shows some of this

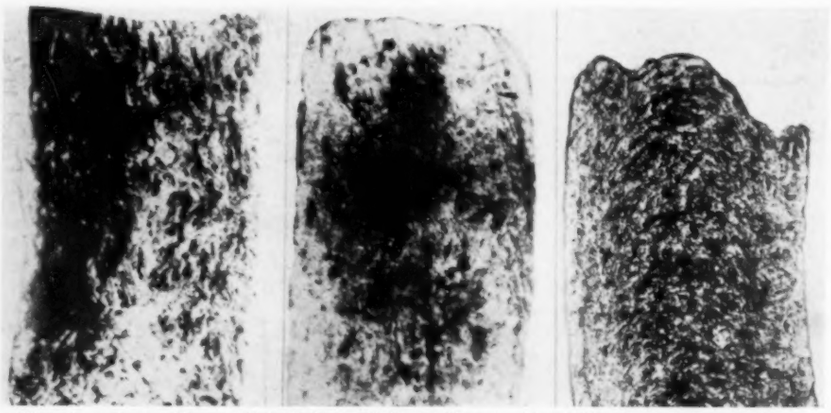


Fig. 5. Non-Uniform Distribution of Guncotton in Guncotton-Pyro Compositions.

Fig. 6. The Cracking of Water Stored Grains.

relatively soggy undispersed material in small arms powder grains. This undispersed material, which usually occurs in streaks rather than rounded lumps, always has a lower index of refraction than the surrounding material, indicating that it is richer in solvent. In addition to retarding the drying time, the improper reduction of the volatile content of a powder affects it ballistically.

When guncotton is added to pyro to increase the potential of the powder there is likely to be an irregular distribution of the guncotton in the finished grains. The undispersed guncotton will burn faster than the gelatinized pyro

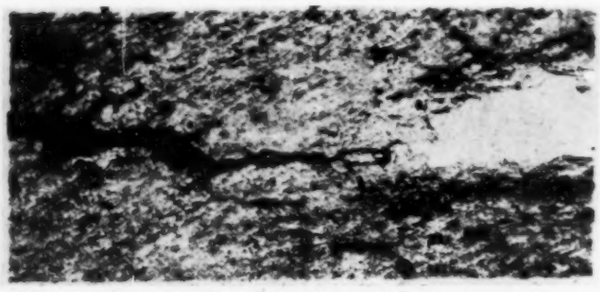


Fig. 7. Characteristic Widening of Cracks, Away from Perforation.

and, if it is localized in spots, the pressures developed will be irregular. Fig. 4 shows some of the irregular exteriors in caliber .50 grains from the same lot of a guncotton - pyro composition. It is fairly obvious that there will be variations in the stability life of these grains, due to the presence of undispersed guncotton at the surface of the grains; ungelatinized, undispersed nitrocellulose being less stable, with respect to heat and moisture, than gelatinized, well-dispersed material.

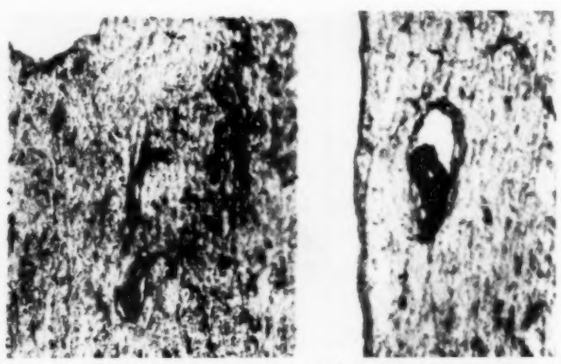


Fig. 8. Voids in Sections from Water-Stored Powders.

Fig. 5 shows three grains from a 60-40 guncotton-pyro composition in which the dark masses of guncotton are differentially distributed; in the first case, along the side of the grain; in the second case, localized in the center. In the third case, friction along the walls of the die caused the material to flow faster through the center than along the edges, thus forming a series of arcs. This is of importance in connection with plasticity measurements for the control of compositions. It indicates that plug flow does not always occur through the die but that slippage occurs with some compositions and must be taken care of in any plasticity formula.

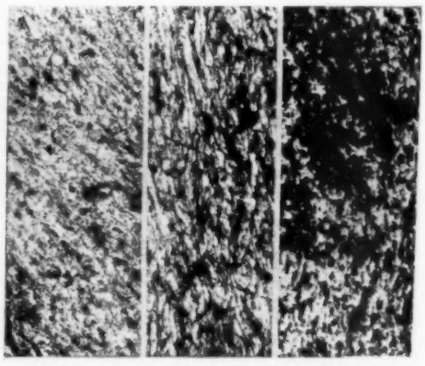


Fig. 9. Structure of Unstable Grains.

IN connection with experiments on the storage of smokeless powder under water, periodical examination has shown that some of the lots stored under these conditions are gradually losing residual solvent and becoming faster

Fig. 10. Nitrocellulose in Transmitted and in Polarized Light with Crossed Nicol Prisms.

burning. Some interesting structures have been found which throw light on why solvent is being lost. Fig. 6 shows cracks in sections from water-stored grains. The photograph at the left shows a large crack and small radiating cracks, while the one at the right shows a characteristic large crack. Except in a few instances, these cracks do not reach the exterior of the grains. Most of the cracks observed ran into the perforations and were smallest at the perforations. Fig. 7 shows the characteristic widening of the crack away from the perforation, the grain having been sectioned at an angle so that part of the perforation on the right is exposed. The inference may be drawn that these grains were case hardened to some extent during drying; that subsequent loss of solvent at a slower rate through the vapor-clogged perforations kept the walls in a more pliable condition and that when shrinkage from loss of solvent took place, there was a warping and cracking within the grains, rather than at the exterior case hardened surface.

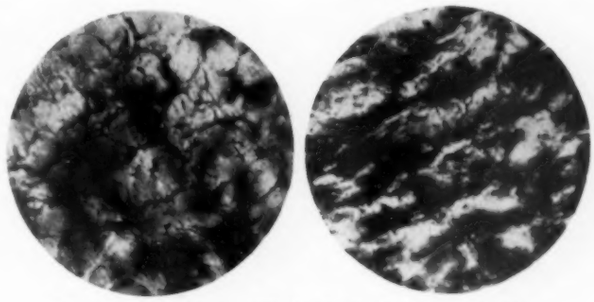


Fig. 12. Shrinkage Effects in Grain Cross Section.

Another way in which solvent was lost was through the development of voids caused by the differential shrinkage of undispersed material. Fig. 8 shows two sections in which voids have developed. Examination in polarized light showed that the dark colored lumps had a high double refraction indicating that this material was undispersed nitrocellulose. This is a very striking instance of the undesir-

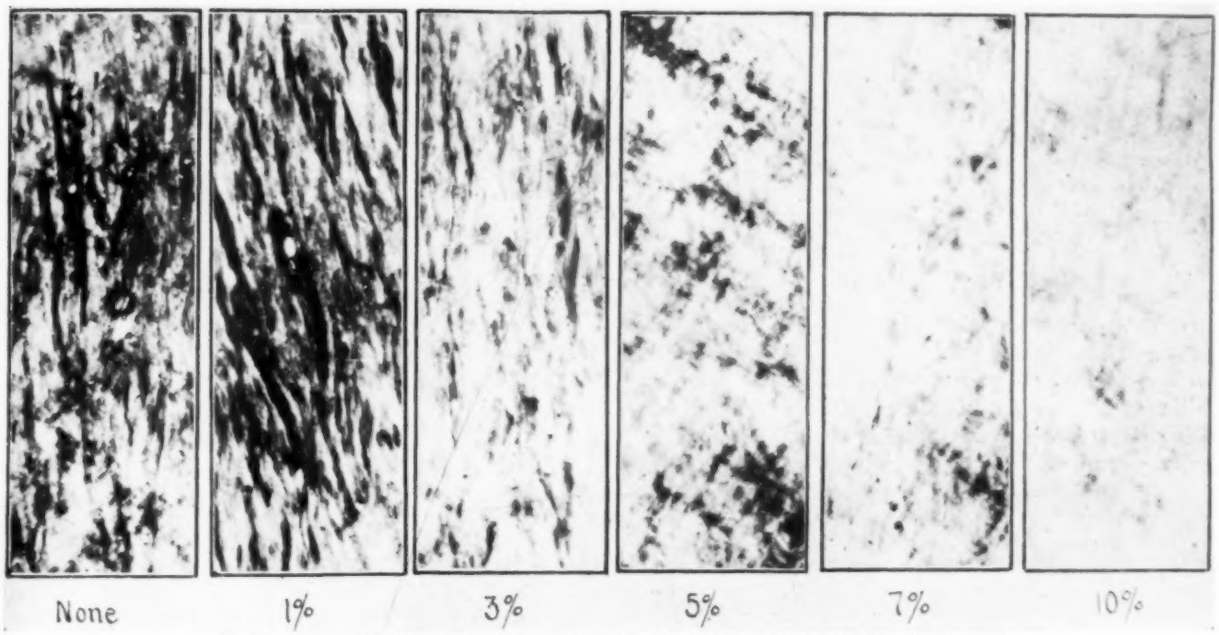


Fig. 11. Increased Dispersion with Increasing Amounts of Non-Volatile Gelatinizer.

Fig. 13. Structural-Variations in Powders Containing Non-Volatile Gelatinizers.

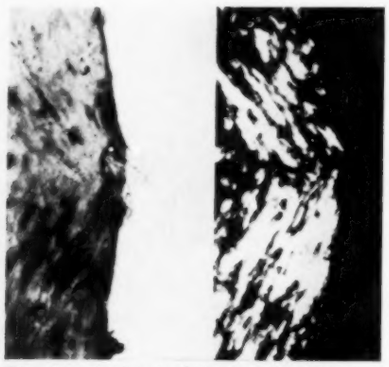


Fig. 14. Mechanical Separation of Low and High Viscosity Materials.

ability of undispersed lumps of material in a powder grain and shows some of the shrinkage effects which may be expected with long time storage when there is appreciable loss of solvent.

With the dry storage of powder grains, slightly dissimilar conditions have been encountered in connection with breakdown in structure, loss of solvent and development of instability. Fig. 9 shows sections from grains in three different stability stages, taken from a lot of 20-year-old, straight nitrocellulose powder which developed acidity and became unstable. The photograph on the left shows the normal structure of the powder; the middle section, the breakdown of the cementing material in between the pin plate vermicelli strings, and the right-hand photo, the development of opaque patches due to the upsetting of structure by the action of nitrous fumes.

WHEN, in addition to the volatile ether and alcohol used as gelatinizing agents, a nonvolatile gelatinizing agent is employed, a refinement in structure is encountered and more use is made of polarized light in interpreting the structures seen. Doubly refracting materials such as nitrocellulose, when placed between two Nicol prisms in crossed position, twist the beam of light and the resulting action is as though the prisms were twisted out of the 90° position. The amount of light passing varies with the double refraction of the material. Nitrocellulose is highly doubly refracting and when placed between crossed Nicols in polarized light appears white on a dark field. Fig. 10 shows its appearance in transmitted light and in polarized light, with crossed Nicols. If the nitrocellulose is completely gelatinized and dispersed by a solvent, its double refraction disappears; but if only partially dispersed, its double refraction is partially retained. These changes in degree of dispersion are well illustrated by Fig. 11, which shows sections of powder grains containing increasing amounts up to 10 per cent of a nonvolatile gelatinizer. With better dispersion there is a drop in the time required to dry the material to a definite volatile content. For instance, powder corresponding to that in the extreme left-hand section required 154 days drying to reduce the volatile content to 1 per cent while that corresponding to the extreme right-hand section required only 20 days. The dark stringers at the left have a dark blue color and the background, instead of being black—which is characteristic of well dispersed nitrocellulose—has a yellow color due to strains set up in drying and the subsequent development of double refraction.

Variations in shrinkage, due to the incomplete incorporation of nitrocellulose of different viscosities, have been frequently noted in grains of this type containing a nonvolatile gelatinizer. A solvent effect is exerted on the guncotton causing it to swell and thereby increasing its viscosity while there is not a corresponding effect on the pyro. A viscosity gradient is thereby set up and, unless the two types of material are thoroughly incorporated, there will be areas in the dried grain which vary in density. Fig. 12 shows an effect of this kind. The grain cross section at the left, by transmitted light, apparently shows dark streaks of insoluble material. In reality, however, these are the welding boundaries of the vermicelli strings made by the pin plate die, and the material at these boundaries has shrunk and produced dense areas which prevent the passage of light. This is shown by the cross section at the right, which is taken in oblique, transmitted light. In Fig. 11, the sections shown, have a yellow background. This is due to the fact that during drying, strains were set up which caused the material to become doubly refracting. Strain double refraction is encountered in material which otherwise would not be doubly refracting. In Fig. 13 there are shown a number of sections from powders containing nonvolatile gelatinizers which illustrate the structural variations encountered. They have the normal black background in polarized light with crossed Nicols, and show light blue streaks of varying widths. These streaks are viscous, impermeable masses which are elongated during passage through the die. They are not so well dispersed as the surrounding material and the principal effect noted in connection with them is their effect on shrinkage.

VERY pronounced effects due to the separation of materials of differing viscosities have been encountered and an effect of this kind is shown in the grain section at the right of Fig. 13. This is a longitudinal section from a guncotton-pyroxylin composition instead of the usual guncotton-pyro mixtures. Another view of this section is shown in Fig. 14, the image at the left being taken with axial transmitted light, while that at the right was taken with crossed Nicols and polarized light. Release of pressure at the mouth of the die has caused a structural distortion. Low viscosity material has thereby been forced through the mass of higher viscosity and the streaks, instead of being parallel to the direction of extrusion, have been pushed off at an angle. Inspection of the transmitted light section shows that material was squirted out of the grain.

The effect due to the mechanical separation of materials of differing viscosities is shown in many grains and may be encountered when multiple blends of various nitrocelluloses are employed. Fig. 15 shows some of the extremes in exterior characteristics which are encountered.

It is a pleasure to acknowledge the assistance and coöperation of Mr. F. R. Seavey in preparing and photographing many of the specimens reproduced in this article.

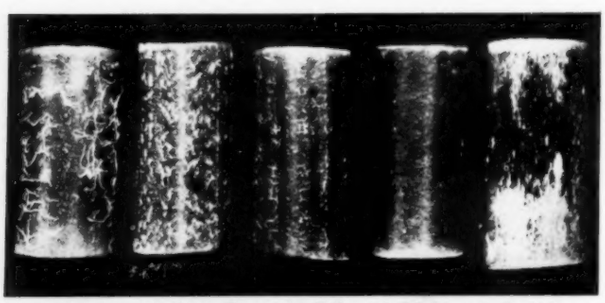


Fig. 15. Surface Characteristics of Abnormal Grains.

A Method for the Survey of Industry

A Proposed Improvement in Planning for Industrial Preparedness

By Walter Soderholm*

ORDNANCE munitions are almost entirely noncommercial and foreign to the peace-time products of industry. In the event of a war, it is estimated that only five per cent of these munitions can be produced by government establishments—the remaining ninety-five per cent must be produced by commercial plants. Hence the importance of industrial preparedness. Its objective, insofar as noncommercial articles are involved, is the preparation of plans, in time of peace, to insure in time of war the earliest possible new production which, together with such stocks as are on hand, will meet the demands for such munitions.

Time is all important in war—but the dire and immediate needs cannot await the arrangement and erection of facilities that will, eventually, produce the great quantities of munitions for which requirements are foreseen. It follows then that early production is of primary importance; and such production must be secured from existing machines and equipment suitable for the manufacture of munitions.

Where are such facilities? It is the paramount duty of the Ordnance Procurement District to seek them out—"to survey industry with a view to determining capacity for the production of ordnance munitions." How can this be done? At present, the District Office attempts this task armed with drawings, photographs and perhaps a "Description of Manufacture" elaborate and detailed, and eventually these aids repose in the manufacturer's lap and he is asked, "Can you make it? How many? When can you start? What additional equipment do you require?"

The response differs. It may be a bluff, "Sure we can make it" coupled with a wide sweep of the arm and a "guesstimate" of how many and when. Can dependable plans be built on such stuff? Or, if the manufacturer had war-time manufacturing experience, his answer is often suspiciously similar to his war-time production record—with visions of new buildings, new machines, more workmen, and time (lots of it!) to get into production. Is early production secured in this fashion? Usually, the manufacturer promises to "look it over," pleads the rush and priority of daily affairs—and after delays, frankly admits that he can't spend the money or devote the time to "analyze the . ."—that without this analysis he can't answer the questions put to him,—that he would like to coöperate insofar as is possible.

WHAT is this "job analysis," the need for which is dogma with the production personnel? It includes a study of the work to be done on each component, the "break-down" into operations, and for each the determination of machines, tools, and time required. It is often a costly effort, and in only a few instances have manufacturers, their time and funds obligated to their daily tasks, prepared such data. Some progress has been made, but the survey of industry's capacity to produce ordnance munitions is still largely before us.

It is the purpose of this paper to support the principle that the Ordnance Department itself should shoulder much of the burden the manufacturer is now asked to bear. It describes the formation and use of a "measuring stick" that can be applied to a commercial plant. But it should not be inferred that the manufacturer is encouraged to assume a passive role in our planning efforts. Coöperation between industry and ordnance must always be the keynote.

THE scheme encompasses two steps, *first the analysis and determination of basic production data*, and *second, the arrangement of this information in a form that will enable the District personnel to survey and determine available capacity*. It is developed and described in this order and in conjunction with an actual test application with an ordnance article.

First, a method of manufacture is worked out, tempered with and incorporating the findings of actual manufacturing experience. It must be a sound, simple, tried, and generally applicable method. Since early production is the objective, it must require so far as possible only such machine-tools as are in general use in industry, and a degree of skill not greater than that ordinarily available.

At this point, an idea that is widespread will be voiced, i. e.,—"There are as many different ways of manufacture, for the same article, as there are factories making it." But like many ideas that have gained currency, this one is but superficially accurate. There are four general methods employed for forming metals, and some other materials, for industrial purposes: melting and casting; pressing into form; cutting with single or multiple edged tools; and welding. These general methods are subdivided into smaller motions or operations; thus, cutting with single or multiple edged tools is resolved into, turning cuts (lathes, turrets, automatics, boring mills), reciprocating cuts (planers, shapers, slotters), milling (milling machines), and grinding (surface, cylindrical, disc, etc.). As noted, definite categories of machine tools have been designed to facilitate the performance of these basic submethods. Every article, commercial or noncommercial, is brought to its final shape by one or several of these basic methods applied by one or more of these machine tools.

True, there are operations which can be performed on two different machines; but rarely can they be performed equally as well on either. However, in industry will be found a diversification of machine tools appropriate to the range of operations required. Generally, for each opera

*Executive Assistant, Chicago District Ordnance Office, Captain, Ordnance Department, U. S. Army. In the preparation of this paper Maj. Barrett Rogers, Ord. Res., assisted the author as technical collaborator.

This paper and portions of the discussion, which follows, were presented by the author at the annual conference of Ordnance District Chiefs in Washington, D. C., October 8, 1930.

tion there is a machine in a class of machine tools which is best adapted. Grinding must be done on appropriate grinders, turning on machines specifically designed for such cuts, sandblasting on a sandblaster, and so on.

So, from the raw materials through the machines and equipment utilized to bring products to their final forms, "different ways" are not often met with—rather, different dimensions are. Common to all products are the methods and machines used to fabricate them.

But in the realm of manufacturing technique—in those activities known as "tooling-up," there, indeed, do differences appear. In view of the production achievements of our modern factories, it does not seem rash to deduce therefrom that where good machines and equipment are found, there also is the knowledge of their use. The scheme proposed permits individual technique and ingenuity full play. It is not concerned with technique—the problem is to find the existing facilities to which this technique can be applied to produce ordnance.

RETURNING to the consideration of the preparation of a generally applicable method of manufacture—it is fruitless to argue as to whether the method is the best one or not. Early production efforts usually cost more than later straight-line production. But such early production, to satisfy the definitely foreseen deficits in the early months of war, will be worth many times more than it costs. In time of peace the production personnel who decrease *costs* are labeled "efficient"—but in the early months of a war they will merit praise only if they save *time*. Production economies can and will be instituted, but they must be effected along with early production and not at the expense of it. So, then, the manufacturing method selected may not be the best, but—and this is the heart of its value—it will be based on actual manufacturing experience; and given the required machines, the production it offers can be duplicated at least. Actually, it ought to be bettered.

To whom shall the preparation of these basic data be entrusted? Experimental models of ordnance, or "pilots," are manufactured largely in the arsenals. They must be built as development pieces have always been built—of such materials and by such methods as are readily available for single piece production. To do otherwise would result in making costs, already unavoidably high, prohibitive. After tests and the incorporation of recommended changes (primarily functional in effect) the design is standardized for future production. Does the method of manufacture as shown by the arsenal's route sheets meet the requirements? Partially! In industry much happens to a design between the time it issues from its tests and before it is released for production. It comes under the relentless attack of the production engineer—a technician who understands and has profound respect for function in a design, but utterly none for "warts," "gadgets," designer's idiosynerasies, "pretties" and custom. When his work is done, the design is unbelievably simpler, easier to make, and adapted for production with the machines and processes in current use in industry. His ability to convert industry's development pieces or "pilots" into readily productible articles, is well known. It is suggested that the preparation of the required basic manufacturing information be entrusted to production engineers in appropriate organizations in the arsenals.

Common to all articles of like materials are the basic methods and machines used to manufacture them. Therefore, an ordnance article can be described not only by name and function, which may mean little to, or even awe, the manufacturer, but in terms of the machines and machine-hours required for its production.

TO illustrate the application of the proposed scheme and test, in general, its possibilities, a small article, the Gunners Quadrant, Model '18, has been selected. For this a method of manufacture has been prepared that meets the requirements and which calls for a suitable diversification of machine tools to bring out the principles involved clearly and briefly. The data as included in the excellent "Description of Manufacture for the Gunners Quadrant, Model '18," require but little modification.

Table 1 is a list of operations, with machines and machine-hours per unit, for the frame—a principal component of the quadrant. All components have been similarly analyzed. For each operation is listed the smallest generally appropriate machine that can handle the work. Any machine or piece of equipment can be suitably described by required capacity, or by number, or by a size and make which will permit comparison. Thus, any disc grinder will handle operation No. 3; a plain milling machine, size No. 1 or larger, will suffice for operation No. 8, etc. For milling machines and screw machines, size numbers indicate closely similar capacities for all makes, but for presses there is no relation between size numbers and capacities of the various makes,—hence a comparison table of all makes of similar capacity is required.

TABLE 1. LIST OF OPERATIONS FOR THE FRAME (GUNNERS QUADRANT) DWG. 15-12L-2.

Material: Bronze, Grade No. 1 Casting

Operation	Machine	Mch-hrs. per Unit
1. Make casting	Foundry	
2. File and straighten casting	Bench	.10
3. Grind one side	Disc Grinder	.04
4. Grind reverse side	Disc Grinder	.05
5. Mill edge opposite pivot hole	No. 0 Plain Milling Mach.	.10
6. Drill and ream pivot hole; drill holes for shoes; drill locating hole	4 Spindle Sens. Drill Press	.125
7. Drill holes for scales and name plate	Sens. Drill Press	.10
8. Mill for shoes	No. 1 Plain Milling Mach.	.125
9. Mill radius for teeth	No. 1 Plain Milling Mach.	.125
10. Broach teeth	No. 20 Bliss Press or equal	.10
11. Tap holes for shoes, remove burs, trim and stamp piece-mark	Bench	.25
12. Paint and fill engraving	Bench	.02
13. Inspect	Bench	.5

Like machine requirements are then grouped and the total machine-hours per unit determined. This gives the "total benchwork-hours," "total No. 1 plain milling machine-hours," and so on, as listed in Table 2. This is a

description of the quadrant in terms of the machines and machine-hours required to manufacture it. Operation No. 1, "Foundry," needs no detailed analysis of the equipment peculiar to melting and casting bronze.

TABLE 2. REQUIREMENTS, MACHINES AND MACHINE-HOURS FOR THE MANUFACTURE OF THE GUNNERS QUADRANT, MODEL '18.

Machines	Unit M.H.	Machines	Unit M.H.
12-inch Engine Lathe	.06	Sens. Drill Press 1 sp.	.39
Bench Lathe	.23	Sens. Drill Press 2 sp.	.15
No. 0 Screw Machine	.06	Sens. Drill Press 3 sp.	.10
No. 1 Screw Machine	.06	Sens. Drill Press 4 sp.	.23
No. 2 Screw Machine	.16	No. 8 Bliss Bench Press	.01
No. 00 Hand Mill. Mach.	.22	No. 20 Bliss Punch Press	.12
No. 0 Plain Mill. Mach.	1.08	Power Saw	.02
No. 1 Plain Mill. Mach.	.35	Small Gas Furnace	.01
No. 2 Plain Mill. Mach.	.10	Japanning oven (cu. ft-hrs).	1.00
No. 2 B & S Surf. Grinder	.13	Sandblaster	.50
Disc Grinder	.09	Bench work, Assembly Test, Inspection	4.00

There are several components of the quadrant which will, most probably, be purchased rather than produced by the shop making the quadrant proper. Facilities with special equipment for the production of these commercial units are found in every manufacturing area. They should be utilized. Items to be purchased are listed in Table 6, and are not included in Table 2.

TABLE 2 is used to construct the "measuring stick" (tables 3, 4, or 5) for use in the Districts. The quadrant being an instrument of precision and requiring accurate machining, factories selected for survey will be those whose products require a comparable workmanship as noted on the survey sheets. Consider Table 3, one of three actual surveys. Machines required and machine-hours per unit are listed in columns 1 and 2. In column 3 are entered the number of machines which this factory has of capacity at least equal to those required. Column 4, available total machine-hours, is the product of hours per month (250) times column 3. Units of production, column 5, are found by dividing column 4 by column 2. Columns 6, 7, and 8 will be considered later.

Tool-room equipment is not ordinarily considered as available for production. This factory has three lathes, which give, in a 250 hour month, 750 machine-hours. And 750 machine-hours, where .06 machine-hours are required per unit, will deliver 12,500 units of production. "Set-up" time is not considered separately—it is included in unit time requirements, which are ample. It is apparent from Column 5, that, in this plant a "bottleneck" exists in milling machines—and perhaps in drill presses. No. 00 Hand Milling Machines are not available, but these operations can be done on the larger No. 0 plain milling machine, and those in the compass of the No. 1 machine are also possible on the No. 2 plain milling machine. This permits the determination of the group production from all milling machines — their total available machine-hours (col. 4) divided by the total unit machine-hours required on milling machines (col. 2), which is 714, the figure inserted vertically between the brackets. Similarly, since 1 and 2 spindle drill presses may be grouped for multiple spindle operation—an average production of 1149 units are available from them. There is no punch press, Bliss No. 20 or equal, available, and the foot press may or may not handle the work for which a bench press is best fitted.

What is the present capacity of this facility? In this case the limiting figure is set by the milling machines—714 quadrants per month, with a punch press and sandblaster required. Assume that the schedule of production calls

TABLE 3.

ITEM: QUADRANT, GUNNERS, MOD. '18 — SURVEY No. 1 — PLANT *Gaertner Scientific Corporation* — DATE *Aug.* 6, 1930 — CHICAGO, ILLINOIS

REQUIREMENTS (1)	(2)	AVAILABLE (3)	(4)	(5)	OVERS AND SHORTS (6)	(7)	(8)	REMARKS
Machines	Unit Mach-hrs	Number of Machines	Total Mch-hrs	Units of Production	Units of Production	Total Mch-hrs	Number of Machines	
12-in. Engine Lathe	.06	3	750	12500	12100			
Bench Lathe	.23	10	2500	10870	10470			
No. 0 Screw Machine	.06	1	250	4133	3733			
No. 1 Screw Machine	.06	1	250	4133	3733			
No. 2 Screw Machine	.16	1	250	1562	1162			
No. 00 Hand Mill. Machine	.22	0	0	0	—400			*The No. 1½ can handle work specified for the No. 2 at a slower speed.*
No. 0 Plain Mill. Machine	1.08	2	500	[714] 463	[314] +63			
No. 1 Plain Mill. Machine	.35	2	500	1428	+1028			
No. 2 Plain Mill. Machine	.10	1—**No. 1½**	250	2500	2100			
No. 2 B&S Surf. Grinder	.13	1	250	1923	1523			
Disc Grinder	.09	2	500	5555	5155			
Sens. Drill Press 1 sp.	.39	2	500	[1149] 1282	[749] 882			*Ample spindle capacity. Machines can be grouped for multiple spindle operations.*
Sens. Drill Press 2 sp.	.15	2	500	3333	2933			
Sens. Drill Press 3 sp.	.10	0	0	0	—400			
Sens. Drill Press 4 sp.	.23	0	0	0	—400			
No. 8 Bliss Bench Press	.01	(1 foot press)	0	0	—400	—4	—?	
No. 20 Bliss Punch Press	.12	0	0	0	—400	—48	—1	
Power Saw	.02	2	500	25000	24600			
Small Gas Furnace	.01	1	250	25000	24600			
Japanning Oven (cu-ft. hrs)	1.00	1—150 cu. ft.	37500	37500	37100			
Sandblaster	.50	1	250	500	100			
Bench work								
Assembly Test	4.00	10 men	2500	625	225			
Inspection								

Hours per month 250. Total toolmaker hours required 600; available **750**. Production starts in **3** *weeks*.
Production assigned **400** per month. Present capacity **714** per month.
Equipment shortage,
1—*No.* **20** *Bliss punch press, or equal.*
Note: Workmanship required comparable to fine brasswork, instruments, precision devices.

Table 4.

ITEM: QUADRANT, GUNNERS, MOD. '18 — SURVEY No. 2 — PLANT *Central Scientific Company* — DATE *Aug.* 7, 1930 — CHICAGO, ILLINOIS

REQUIREMENTS (1)	(2)	AVAILABLE (3)	(4)	(5)	OVERS AND SHORTS (6)	(7)	(8)	REMARKS
Machines	Unit Mach-hrs	Number of Machines	Total Mch-hrs	Units of Production	Units of Production	Total Mch-hrs	Number of Machines	
12-in. Engine Lathe	.06	7	1750	29166				
Bench Lathe	.23	16	4000	17391				
No. 0 Screw Machine	.06	1	250	4166				
No. 1 Screw Machine	.06	1	250	4166				
No. 2 Screw Machine	.16	1	250	1562				
No. 00 Hand Mill. Machine	.22	2	500	2272				
No. 0 Plain Mill. Machine	1.08	1	250	231 (1307)				
No. 1 Plain Mill Machine	.35	4	1000	2857				
No. 2 Plain Mill. Machine	.10	3	750	7500				
No. 2 B&S Surf. Grinder	.13	2	500	3846				
Disc Grinder	.09	2	500	5555				
Sens. Drill Press 1 sp.	.39	10	2500	6153 (5183)				
Sens. Drill Press 2 sp.	.15	3	750	5000				
Sens. Drill Press 3 sp.	.10	4	1000	10000				
Sens. Drill Press 4 sp.	.23	1	250	1086				
No. 8 Bliss Bench Press	.01	1	250	25000				
No 20 Bliss Punch Press	.12	1	250	2083				
Power Saw	.02	2	500	25000				
Small Gas Furnace	.01	1	250	25000				
Japanning Oven (cu-ft. hrs)	1.00	1 (40 cu. ft.)	10000	10000				
Sandblaster	.50	0	0	0	—800	—400	—2	
Bench work Assembly Test Inspection	4.00	15 men	3750	937				

Hours per month 250. Total toolmaker hours required 600; available **750.** Production starts in **3** *weeks.*
Production assigned **800** per month. Present capacity **1307** per month.
Equipment shortage,
2—*Sandblasters*
Note: Workmanship required comparable to fine brasswork, instruments, precision devices.

only for 400 per month. What equipment shortage exists for this "assigned" production? Column 6 is the units of production over or short of the assigned production, i. e. column 5 minus 400. In the case of the milling machines and the drill presses, the average units of production is used i. e. 400 subtracted from 714 and 1149 respectively. Thus, units of production minus or short, are: bench press, 400, and punch press, 400. How many punch presses, Bliss No. 20, or equal, will be required to meet this shortage? Column 7 is the product of Column 6 and Column 2; units of production short converted into machine-hours short; in this case, 48. And since one press can supply 250 machine-hours, it is obvious that one punch press, No. 20 Bliss, or equal, is more than sufficient, this being entered in Column 8, (Col. 7 divided by 250). Similarly, only four machine-hours of work on the bench press are short. The foot press may be able to handle this small job—if not, a bench press is also required. Plans can be made to meet this equipment shortage—the sensible thing to do is to find available ones in the locality and either arrange to move the idle presses where they are needed, or "farm out" the work.

When can deliveries start? When the method of manufacture was prepared, the essential fixtures, jigs, tools, test devices, etc. were selected and an estimate made of the total toolmaker-hours required to make them all. Obviously, production cannot get under way until the essential tooling is completed. Admitting variations in design; admitting even that one shop may get along without a fixture where another shop may require it; it is a fact, that for similar tasks and quantities total toolmaker-hours required in either shop on the entire job of tooling-up will not vary greatly. We are justified in selecting the fixtures, jigs, tools, etc., required to enable early production to be initiated expressing this task as "total toolmaker-hours" required. For the quadrant, it amounts, conservatively, to 600 hours. The facility being considered (table 3) has three toolmakers generally available, or 750 toolmaker-hours. Since only 600 toolmaker-hours are required, deliveries can start in about three weeks. In this case the patterns for the bronze castings can be made and deliveries of castings initiated in about ten days, i. e., in less time than required for tooling-up. If more time were required the start of production would depend on their delivery.

The time required to reach capacity production depends on several factors, especially process time, and it appears that each case will require consideration to yield a satisfactory estimate.

The second survey, Table No. 4, indicates a present capacity of about 1307 quadrants per month, with sandblasters required. The assigned production, in the example, is 800 per month. Columns 6, 7, and 8 are completed for the sandblaster, showing a shortage of 400 hours or two machines. Deliveries can start in about three weeks.

The third survey, Table No. 5, shows that present capacity is about 817 per month, with an equipment shortage of one japanning oven and one sandblaster. The assigned production, 1200 per month, however, is greater than present capacity. Columns 6, 7, and 8 have been computed where necessary. Lathe requirements are so small, they may be met by using tool-room equipment. The shortage in milling machine "units of production" for the No. 0, No. 1 and No. 2 sizes is 383.

Converting this group figure to group machine-hours short, by multiplying by the sum of the corresponding unit milling machine-hours required, it is found that 590 machine-hours are short. Since one machine supplies 250 machine-hours, two or three milling machines, preferably size

TABLE 5.

SURVEY **No. 3** DATE *Aug.* 20, 1930
ITEM: QUADRANT, GUNNERS, MOD. '18 PLANT *Imperial Brass Company* CHICAGO, ILLINOIS

REQUIREMENTS (1)	(2)	AVAILABLE (3)	(4)	(5)	OVERS AND SHORTS (6)	(7)	(8)	REMARKS
Machines	Unit Mach-hrs	Number of Machines	Total Mch-hrs	Units of Production	Units of Production	Total Mch-hrs	Number of Machines	
12-in. Engine Lathe	.06	**0**	**0**	**0**	**—1200**	**—72**		*Can use tool-room lathe*
Bench Lathe	.23	**3**	**750**	**3260**	**2060**			
No. 0 Screw Machine	.06	**6**	**1500**	**25000**	**23800**			
No. 1 Screw Machine	.06	**8**	**2000**	**33333**	**32133**			
No. 2 Screw Machine	.16	**15**	**3780**	**23625**	**22425**			
No. 00 Hand Mill. Machine	.22	**3**	**750**	**3409**	**2209**			
No. 0 Plain Mill. Machine	1.08	**2**	**500**	**463**	**—737**			
No. 1 Plain Mill. Machine	.35	**2**	**500**	**1438**	**+238**		**—2 or 3**	
No. 2 Plain Mill. Machine	.10	**1**	**250**	**2500**	**4300**			
No. 2 B&S Surf. Grinder	.13	**1**	**250**	**2000**	**800**			
Disc Grinder	.09	**2**	**500**	**5555**	**4855**			
Sens. Drill Press 1 sp.	.39	**5**	**1250**	**3205**	**2005**			
Sens. Drill Press 2 sp.	.15	**1**	**250**	**1666**	**466**			
Sens. Drill Press 3 sp.	.10	**1**	**250**	**25000**	**23800**			
Sens. Drill Press 4 sp.	.23	**4**	**1000**	**4347**	**3147**			
No. 8 Bliss Bench Press	.01	**2**	**500**	**50000**	**49800**			
No. 20 Bliss Punch Press	.12	**2**	**500**	**4166**	**2966**			
Power Saw	.02	**1**	**250**	**12500**	**11300**			
Small Gas Furnace	.01	**1**	**250**	**25000**	**23800**			
Japanning Oven (cu-ft. hrs.)	1.00	**0**	**0**	**0**	**—1200**	**—1200**	**—1, small**	
Sandblaster	.50	**1**	**250**	**500**	**—700**	**—370**	**—2**	
Bench work Assembly Test Inspection	4.00	**20 men**	**5000**	**1250**	**50**			

[817] [−883] [−590]

Hours per month 250. Total toolmaker hours required 600; available **3750.** Production starts in *about* **2** *weeks, after raw materials are available.*
Production assigned **1200** per month. Present capacity **817** per month.
Equipment shortage,

2 *or* 3 *No.* 0 *or No.* 1, *Plain Milling Machines*
1 *Japanning oven, medium or small*
2 *Sandblasters*

Note: Workmanship required comparable to fine brasswork, intruments, precision devices.

No. 0, are needed, but size No. 1 will also serve. A japanning oven is required and two additional sandblasters. Deliveries can start in about two weeks if raw material is available, there being fifteen toolmakers employed.

Labor and power can be considered together. A month of 250 hours was selected, a 10-hour day and 25 days a month. The objective is to uncover existing facilities, hence capacities have been based on labor ordinarily required to serve the machinery installed. This labor can work a 10-hour day. Of course, two 10-hour shifts can be employed to hasten and increase production. But it takes time to secure and organize the second shift. Further, the migration of labor, attended by the ills peculiar to it, should be encouraged only when definitely required. Basing the survey results only on machines and labor available is also in accord with the accepted policy of planning to utilize not more than 50 per cent of a facility's capacity. Power, considered in a like manner, is sufficient insofar as existing equipment (for which power is adequate) can be made sufficient for our needs. Certainly, it is futile to attempt to forecast power requirements until it can be determined to what extent existing capacity is or is not sufficient. On the whole, where the machine is—there is found the power it requires and the labor to operate it.

TABLE 6.

Components to be Purchased by Contractor

Screw, flat head, A-31809B
Screw, clasp, A-38862
Screw, Headless, flat, A-31911A
Screw, filister head, A-31738A
Screw, filister head, A-31757A
Screw, filister head, .099 dia. x .625
Vial, level, A-31316
Scale, elev., rt. XH-2D
Scale, elev., lt. XH-2C
Plate, name, XH-2A
Spring, A-38867
Cotter pin, HFAX-1BB

IN conclusion, it is believed that this method for the survey of industry offers the following advantages:

1. For the current delays and uncertain progress, a definite and practical procedure under the Department's control, is substituted.
2. The following data, based on existing facilities, can be secured:
   a. The ordnance a factory is best equipped to produce.
   b. A conservative and dependable estimate of capacity.
   c. The time required before deliveries can start.
   d. Additional equipment required.
3. The ready orientation of procurement plans to meet changes in industry or the adoption of new ordnance designs, is made possible.
4. The widest use of available facilities will be encouraged. The fundamental importance of the equitable distribution of the war procurement load on industry cannot be over-stated. Inasfar as it can be achieved, the problems of equipment, power and labor will be minimized.
5. The purchase of new machines—while installed and available machinery stands idle—will be minimized. (This will decrease the post-war availability of used machines, sparing the machine-tool builders a repetition of their ruinous post-war market).

6. It will permit industry's coöperation without interfering with and detracting from their daily interests.
7. With existing capacity to produce munitions actually determinable, it will permit the preparation of a military program for the efficient utilization in the early months of a war, of such definite fighting forces as industry is able to support.

It is recommended,

1. That provision be made in the Department's organization for competent engineers whose role it will be to:
   (a) Revise ordnance designs before standardization for future manufacture and as required thereafter, to incorporate suitable materials in current use, and to insure the maximum productibility with processes and machines currently and generally used in industry.
   (b) Prepare for these designs methods of manufacture that shall be simple, tried and generally applicable to, and possible of execution by, the processes, machines and skill found currently in industry.
   (c) Describe each article or component in terms of the machines and machine-hours required for its manufacture, and provide the District Offices with these lists in a form suitable to their needs.
2. That the Ordnance Districts then proceed to survey industry by utilizing the lists of required machines and machine-hours as "yard sticks" with which to measure the ability of existing facilities to produce ordnance munitions.

The method appears practical. Its application to the gunners quadrant was without difficulty and bespoke no challenge of its soundness. It incorporates nothing new or untried in the manufacturing arts, being but a particular application of well known production facts and principles. It is offered as a solution to an important and long-standing problem.

Discussion

THE following are extracts from letters written to Captain Soderholm regarding his proposed method for a survey of industry:

MILFORD D. BURROWS, Milford D. Burrows, Inc., Industrial Engineers, Chicago, Illinois: "The project is in full accord with the general practice in industry today. In our work, supplying new products to manufacturing concerns, we have followed much the same general plan. While ordnance munitions are quite largely non-commercial, the operations necessary to manufacture this class of product are entirely standard and the average manufacturer will more quickly understand the requirements and be better able to judge his manufacturing capacity, if the problem is put to him in terms of machine hours and operations required.

"The nomenclature used in an experimental shop in the arsenal is quite likely to be different from that used in the large production shops throughout the country and it seems reasonable to suppose that the transposition into ordinary working language should be the Department's burden. I believe that it is not only possible but also simple and desirable to survey a plant and list the things which that plant can do best and the amount of their capacity.

A. A. HADDEN, Manager, Western Division, Thompson and Lichtner Co., Inc., Engineers, Chicago, Ill.: "We believe that the proposed method is entirely practicable and consider it sound in principle. The results will of course be entirely dependent on the care and accuracy with which the articles are described and the data collected. Production men would welcome the method of survey."

D. D. FENNELL, Consulting Industrial Engineer, Chicago, Ill.: "The method outlined in this comprehensive paper is practicable and in line with the best production practice. If a competent industrial engineer were called upon to make a survey of the factories' machines and their capacities that could be used for the manufacture of ordnance articles when needed, he would use quite the same order of approach as is suggested in this paper.

W. R. WILLIAMSON, Consulting Industrial Engineer, Chicago, Ill.: "The plan is sound in principle and is one that would not be difficult to carry out. In my opinion the acceptance of the principles of this plan, and the setting up of an adequate mechanism for putting them into effect would constitute a preparedness measure of primary importance."

E. H. LICHTENBERG, Chief Engineer, Koehring Co., Milwaukee, Wis.: "On the whole, I believe this paper advocates a sound principle which, if carried out, will prevent unnecessary scrambling of industry in turning from peaceful pursuits to wartime requirements. A production man's language consists mainly of the basic yard stick of lathe-hours, drill-press hours, etc. and the Ordnance Department can certainly describe its articles in these terms. The suggested method will take an essentially complicated problem and reduce it to the simple everyday recognizable language of production.

EARLE D. PARKER, Works Manager, Barber-Colman Co., Rockford, Ill.: "To the question, Is the proposed method for the survey of industry sound in principle and practicable and will the results of such a survey yield a dependable estimate of a plant's production ability?—I reply in the affirmative."

The following remarks approving Captain Soderholm's plan were made at the annual conference of Ordnance District Chiefs in Washington, D. C., October 8, 1930:

COL. HARRY SCULLIN, ORD. RES., U. S. A., ASSISTANT DISTRICT CHIEF, ST. LOUIS ORDNANCE DISTRICT; PRESIDENT, SCULLIN STEEL COMPANY: "I feel that for our District the Captain's idea is very sound. Our first need is determining the additional machinery."

COL. T. C. DICKSON, ORD. DEPT., U. S. A., COMMANDING OFFICER, WATERTOWN ARSENAL: "It seems to me that this plan is one of the best I have heard in connection with Preparedness. It is the basic thing the Districts want."

COL. J. W. JOYES, ORD. DEPT., U. S. A., COMMANDING OFFICER, SPRINGFIELD ARMORY: "For some years the need of getting factory plans has been apparent. There is no question that a basic, simple method along the lines suggested will do a great deal of good."

LIEUT. COL. J. E. MUNROE, ORD. DEPT., U. S. A., COMMANDING OFFICER, FRANKFORD ARSENAL: "I am very enthusiastic about the paper. The author should be commended very highly for it. . . . If we give him these data, he can quickly determine whether the plant is adapted to manufacture a particular item."

Simulation of Setback of a Projectile

Determining the Safety of an Untried Design

By I. A. Luke*

IT is often desirable and sometimes necessary to test a new design of projectile to ascertain whether there is a reasonable margin of safety for trial in a weapon. This is particularly true when any wide departure, either in composition of metals used, form of projectile, relative position of component parts, or type of loading is made from previous successful designs. Bombs, and especially their loading, are tested also for the purpose of determining whether the components making up the fuze assembly, booster, bursting charge, and body will meet the requirements for dropping "safe."

It is necessary, for example, that a bursting charge of a projectile successfully withstand, and by a safe margin, the forces of "setback" in a weapon in order that there may be assurance against prematures in or near the gun tube and also to guarantee maximum efficiency at the point of burst or impact. It is in some cases, for instance, a regular part of the procedure of development to test the functioning of a component part of an assembled round of ammunition where such functioning depends on the force of setback.

WHEN a weapon is fired, the combustion of the propellent powder produces a rise of pressure in the chamber of the gun and thus imparts the necessary kinetic energy to the projectile so that it will emerge at the muzzle with the required velocity. This pressure depends upon the following factors, according to the LeDue formulae:

$$P = \frac{1{,}448{,}000\ \sqrt[6]{\Delta}\ \omega\ u^{\beta}\left(1-\frac{\Delta}{\delta}\right)\sqrt[3]{\left(\frac{S}{W}\right)^2}}{A\left[u+\beta\left(1-\frac{\Delta}{\delta}\right)\sqrt[3]{\left(\frac{S}{W}\right)^2}\ \right]^3}$$

Where P = pressure in the bore in lbs. per sq. in.;
ω = powder charge in lbs.;
W = weight of the projectile in lbs.;
u = distance traveled by the projectile along the bore in feet;

A = cross section of bore in sq. in.;
S = capacity of chamber in cu. in.;
Δ = density of loading = $\frac{27.68\,\omega}{S}$;
δ = density of powder = (1.672 —.0178) percentage of total volatiles remaining in powder, and
β = powder constant depending on the web thickness.

For illustration, the calculated pressure-travel curve for the 155-mm. G. P. F. gun, Model 1918, is shown in Fig. 1. Different values for the travel of the projectile u are substituted in the above formula, and the pressures thus obtained are plotted as ordinates against the travel as abscissae. The pertinent data for this weapon firing the full charge is:

ω = 26 lbs. charge;
W = 95 lbs. weight of projectile;
u = 15.4 ft. total travel of projectile;
A = 29.868 sq. in. cross section of bore;
S = 1342 cu. in. chamber capacity;
Δ = .536;
δ = 1.6;
β = 1.4.

From the curve it may be seen that the pressure rises from 0 to 30,800 lbs. per sq. in. by the time the projectile has traveled a distance of 2.7 feet, and then tapers off to a pressure of 10,500 lbs. per sq. in. at the muzzle. The maximum allowable pressure for this gun is 31,500 lbs. per sq. in.

The projectile is constrained to travel in the direction of the bore, and the change of motion is proportional to the force applied, or

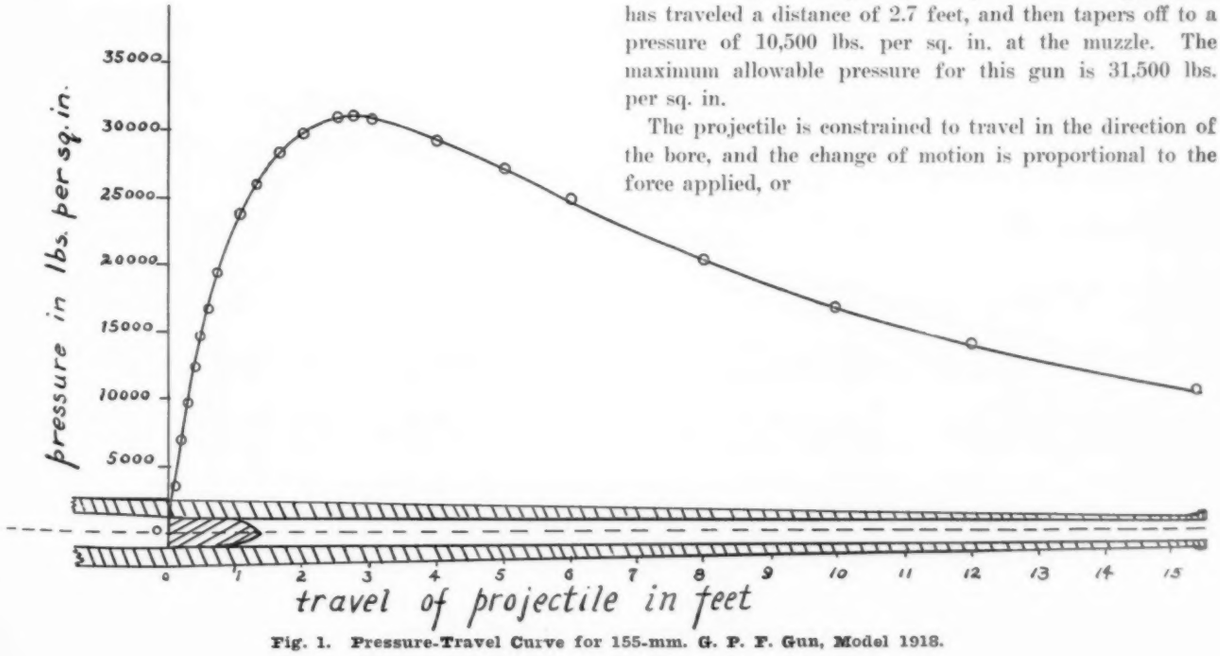


Fig. 1. Pressure-Travel Curve for 155-mm. G. P. F. Gun, Model 1918.

*Leland Stanford University, Calif. Captain, Ordnance Department, U. S. Army.

Force = mass x acceleration = mass x $\frac{d^2u}{dt^2}$, where

u = travel in feet, and
t = time in seconds.

The acceleration "a" is equal to:

$a = \frac{F}{M} = \frac{g\,F}{W}$, where

F = required force in lbs.;
W = weight projectile in lbs.;
g = 32.2 ft./sec./sec., and
a = linear acceleration in ft./sec./sec.

The force F at any point of travel of the projectile in the bore is equal to the pressure of the gases acting over the cross section of the bore, or F = PA

Therefore, $a = \frac{32.2\ P\ A}{W}$ ft./sec./sec.

This accelerating force produces in the various parts of the projectile a reaction called "setback." Note: Setback is defined as the reaction of a mass to a force which produces or tends to produce linear acceleration of that mass.

Since the projectile must be able to withstand the setback at the point of maximum pressure, that maximum value is used in the formula and for the work under discussion.

THE simulation of linear setback is, therefore, a special problem for each weapon, and for each weapon also where different weights of projectiles or different allowable pressures are permitted. In the description of the solution of one such problem in this article, it was thought desirable to set forth a description of the simulation of setback apparatus and some of the experiments that were performed at Picatinny Arsenal, where the apparatus is installed, for the purpose of attempting the proof of such "simulation." At the same time an outline of the theory underlying the work will be undertaken.

The particular weapon chosen for these following computations and tests was the 155-mm. howitzer, Model 1918. The 95-lb. proof projectile was utilized, as it offered safety and could be modified easily.

The maximum linear setback for this projectile in the howitzer is: $a = \frac{32.2\ P\ A}{W} = \frac{32.2 \times 30000 \times 29.751}{95} = 302{,}400$ ft./sec./sec., where P = maximum allowable pressure, for full charge.

The setback in pounds force per grain of weight can readily be computed from the formula:

Force/grain $= \frac{PA}{7000\ W} = \frac{30000 \times 29.751}{7000 \times 95} = 1.34$ lbs./grain.

If an apparatus can be arranged for dropping the projectile on its base from a height such that on impact the projectile is given a negative acceleration equal numerically to the positive acceleration experienced in the weapon, the conditions of setback are simulated.

Let a projectile be dropped from a known height, and the velocity V_2 developed at the instant of impact on a foundation is $V_2 = \sqrt{2gH}$, where g = 32.2 ft./sec./sec., and H = height in feet.

Let V_1 = final velocity = 0 for the projectile when brought to rest. A negative acceleration is exerted in such amount by the resistance of the metal foundation that the velocity of the projectile is changed from V_2 to V_1 in a distance f. It is desired to know the value of f.

$t = \frac{f}{\frac{V_2 - V_1}{2}}$, where t = the time required for the projectile to travel the distance f, and assuming that the metal's resistance varies nearly as the amount of compression.

And, $t = \frac{V_2 - V_1}{-a}$

Eliminate t, and $-2af = V^2$

$f = \frac{V^2}{-2a}$ in feet or $12\,\frac{V^2}{-2a}$ in inches.

The distance f in which the projectile must be brought to rest can also be derived directly from the kinetic energy relation:

$F \times f = \frac{W V^2}{2g}$ or, $PAf = W\,\frac{V^2}{2g}$, and $f = \frac{WV^2}{2gPA}$

Substituting different values for the height of drop in the formula $V_2 \sqrt{2gH}$, and again substituting these obtained values in the above equation for f, the following results are obtained:

Height of drop H	V_2	f
40 ft.	50.7 ft./sec.	.051 in.
45 "	53.7 "	.057 "
50 "	56.8 "	.064 "
55 "	59.5 "	.070 "

It was decided to drop the projectile from a height of 50 feet, and therefore it should be brought to rest within a distance of 0.064-inch to simulate the maximum linear setback experienced in the weapon—except for the element of time involved.

THE "simulation-of-setback" tower at Picatinny Arsenal is arranged so that an automatic release of a projectile from any height within the limits of the apparatus above a foundation can be made. Referring to Figs. 2 and 3, A is the tower proper, P is a heavy lead cylinder which can be suspended at any desired position above the foundation M by means of a cable running over the pulleys B, and controlled by a hand-operated winch C. This lead cylinder is hollow to permit the hoisting cable R to travel through it. The hoisting cable is run by an electric hoisting machine situated sufficiently distant and under cover for safety in case of a detonation when live ammunition is being tested. The cable travels through a pulley at N, over two pulleys B, and down through the suspended lead cylinder P to the

carrying and releasing mechanism which handles the projectile F. The projectile is held in two strap iron clamps (not shown), the upper of which has a bail with an eye which in turn may be grasped by the tongs I. The tongs are held together by the tension of the spring H against the collar G. To secure the release of the projectile, it is only necessary that the collar strike the bottom of the cylinder P. S consists of stabilizing weights for the purpose of keeping tension in the hoisting cable and effecting a smooth release of the projectile.

The foundation upon which the projectile strikes consists of a built-up construction of concrete, followed by square piles close together on end with an exposed area of about 16 square feet. On these is a piece of armor plate 2 inches in thickness bolted down, with one 1¼-inch and one 2½-inch plate on top. Next comes a copper anvil 8½ inches high, followed by a final piece of armor plate 2½ inches thick.

The "give" of the foundation after each impact is measured by a stylus, which may consist either of a sharp-pointed pencil which leaves a trace on a paper fastened to the foundation or a sharp-pointed steel rod which scratches a lead strip. The stylus is supported by an I-beam L, which is independent of the foundation.

Tension in the two guide wires for the falling projectile is maintained by adjusting the heavy lead weights K_1 and K_2 at desired distances along lever arms having fulcrums at the ends.

A slight modification of the standard 95-lb. proof slug was made by boring a hole 6.5 inches in depth and 0.345 inch in diameter in the center of the top (Fig. 4). The bottom of this hole was carefully finished flat to furnish a seat for the copper crusher cylinders used in determining the pressures obtained on impact. A cylindrical piston of diameter 0.335-inch and 6.0 inches length was constructed to slide in the hole in the slug.

The theoretical weight of the piston is calculated from the linear setback data for the howitzer and the copper to be used in combination therewith, as follows:

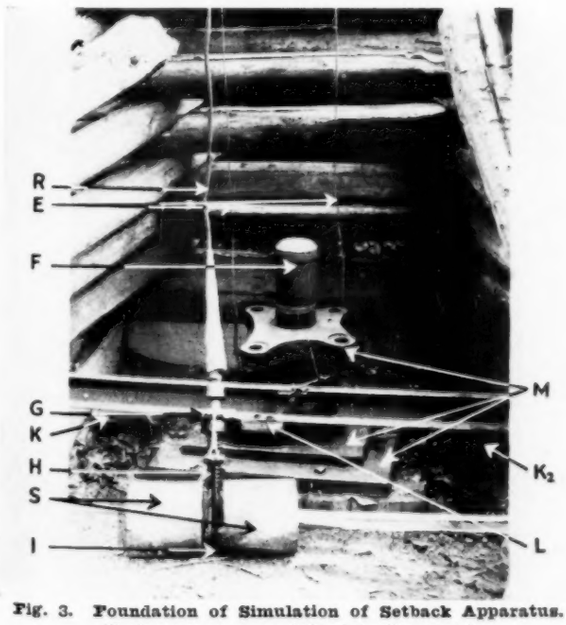


Fig. 3. Foundation of Simulation of Setback Apparatus.
(References are explained in the text.)

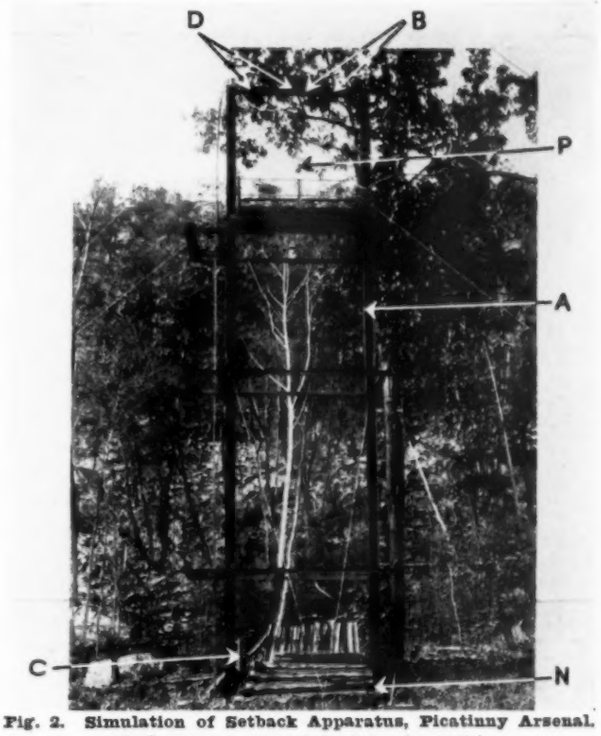


Fig. 2. Simulation of Setback Apparatus, Picatinny Arsenal.
(References are explained in the text.)

The coppers used were 0.400-inch in length; 0.226-inch in diameter, and had not been given any previous initial compression. Therefore the end of the copper cylinder on which the piston rests had an area of 0.04 sq. in. Due to the fact that the tarage table used to indicate the pressures corresponding to the various shortenings of the coppers was constructed for a piston area of 1/30 or 0.033 sq. in., this latter area was used for convenience, rather than to compute a table for the exact area of the copper, i. e., 0.04 sq. in. Since the maximum allowable powder pressure in the 155-mm. howitzer is 30,000 lbs. per sq. in., the force or load which compresses the copper is—

$$F = P \times A = 30000 \times \frac{1}{30} = 1000 \text{ lbs.}$$

The linear setback of the projectile in lbs. force per grain of weight having been computed as 1.34, it is seen that the proper weight of the piston should be 1000 or 746.3 grains.

$$\frac{}{1.34}$$

The piston when finished actually weighed 1042.4 grains. Since however the tarage curve is so nearly linear over the range of pressures involved, direct proportion was used to correct the measurement of pressure made with the heavier piston to that pressure which would have been indicated by the theoretically correct piston of 746.3 grains weight.

The following table gives a series of ten measurements obtained on the same day. The procedure for each drop of the projectile was the same. The proof slug, held erect in the two strap iron clamps, the wooden ends of which slid freely along the two guide wires, was slowly hoisted to the height of 50 feet and automatically released so as to fall without undue wobbling onto the foundation. The stylus was regulated so as to make a mark indicating the "give" downward of the foundation and the return. It is apparent

that the probability of securing a completely square hit by the base of the projectile on the foundation would be fairly small. If any variation between the axis of the projectile and the normal to the surface of the foundation existed, a certain amount of friction to the motion of the piston would result. This friction would vary as the cosine of the angle, being 0 if the projectile struck square—on its base and 100 per cent if it struck on the side.

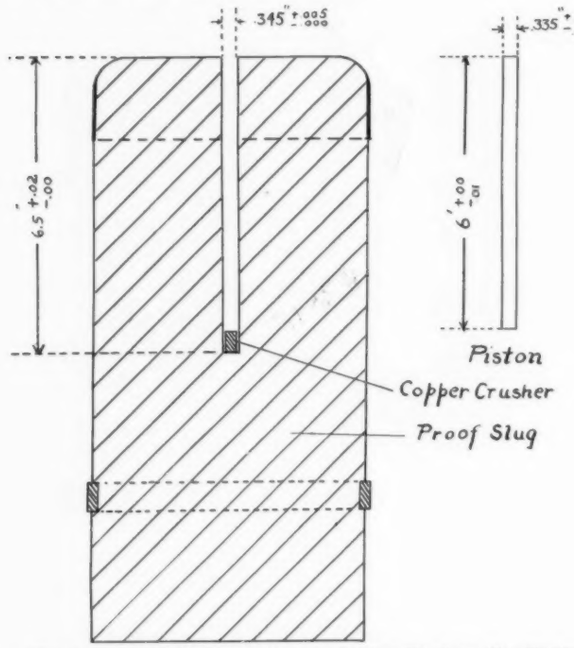


Fig 4. The Modified 95-lb. Proof Slug Used in the Tests.

Determination	Height of drop (h)	Pressure obtained with piston of wgt. 1012.4 grains	Corrected pressure for wgt. of piston 746.3 grains	Measured give of foundation (f)
1	50 ft.	26800 lbs. /sq. in.	19100 lbs./sq. in.	.05"
2	"	41700 "	29800 "	.05"
3	"	41200 "	29400 "	.08"
4	"	28800 "	20600 "	.05"
5	"	31300 "	22400 "	.04"
6	"	44800 "	32000 "	.075"
7	"	32600 "	23300 "	.05"
8	"	42200 "	30200 "	.06"
9	"	28200 "	20200 "	.05"
10	"	34400 "	24600 "	.035"
	Average.	35200	25200	.054"

Thus, it is seen that the average pressure obtained for 10 determinations is 25,200 lbs./sq. in., a value which is approximately 84 per cent of the theoretically expected pressure of 30,000 lbs./sq. in. The hits on the foundation were observed for squareness in as far as possible. The projectile rebounded varying amounts in inches. It may be estimated that perhaps two or three per cent of the kinetic energy of the projectile at the instant of impact is spent in the rebound from the foundation and in heat. The effect of the weight of the strap iron supports was neglected in the computations as this weight was partially offset by any friction of the guide wires. Also, the supports were adjusted to slide easily downward on the projectile when the impact occurred. The average measured "give" of the foundation, 0.054-inch, corresponds to the value of "f" expected for about a height of drop of 42 feet. The method of measuring the value "f" was necessarily crude, but considering the losses of energy due to friction of the projectile with the air, guide wires, etc., losses due to rebound, and the possibility that the foundation was depressed unevenly at times and hence might have been more or less in amount than that indicated, the result is considered reasonable.

THE time comparison between that which is required to bring a projectile to a complete stop within the short distance "f" and that which exists in the attainment of the maximum setback in the 155-mm. howitzer will now be studied. Again using a derived LeDue formula, the length of time the projectile is in the bore of the howitzer during the action on it by a full charge is:

$$t = \frac{u + \log_e u\left[\beta\left(1 - \frac{\Delta}{\delta}\right)\sqrt[3]{\left(\frac{s}{w}\right)^2}\right]}{6823\sqrt{\frac{\omega}{w}}\sqrt[12]{\Delta}}$$, where t is in

seconds and all the other symbols have the same significance as above defined in the pressure formula. Substituting pertinent data for the howitzer in the formula:

$$t = \frac{6.058 + \log_e 6.058\left[.6\left(1 - \frac{60^6}{1.6}\right)\sqrt[3]{\left(\frac{35\omega}{95}\right)^2}\right]}{6823\sqrt{\frac{7.87}{95}}\sqrt[12]{.606}} = 0.0033 \text{ second.}$$

The time actually required by the projectile to travel to the point in the bore corresponding to the maximum setback would be less than .0033-second. For comparison, however, the total time in the bore will be used.

Theoretically, if the falling projectile, on striking the armor plate of the foundation, has a velocity of 56.8 feet per second, and it is brought to rest in a distance of .064-inch, the time t, in seconds, is:

$$t = \frac{.064 \times 12}{\frac{V2 - V1}{2}} = 0.0002\text{-second.}$$

It is thus seen that the simulation of setback by the above method is accomplished in a time interval about 16 times shorter than that in the weapon. Except for this shorter time interval, the setback is believed to be fairly simulated as above described.

The practical value of having available an apparatus such as is above described is apparent. A newly loaded shell or an old shell which may be under suspicion can be "punished" at will and with safety. The procedure is simply to drop the projectile from the previously determined height. If a study of the functioning of the complete projectile is desired, the round may be dropped fuzed. If merely the effect of the setback on the explosive charge of the shell is wanted, it is dropped unfuzed. After such dropping, the shell may then be sawed lengthwise in a sectioning machine and the entire interior studied and photographed. It is possible by the foregoing procedure to predict within reasonable limits whether a new type or condition of loading will withstand the forces encountered in the weapon.

(*Author's Note:* In the preparation of the above discussion, the writer made frequent use of information contained in papers prepared by the members of the Technical Division of the Picatinny Arsenal, Dover, N. J.

Our Twelfth Annual Meeting

Part I: Proceedings of the Business and Technical Session

THE Business and Technical Session of the Twelfth Annual Meeting of the Army Ordnance Association was held in the Auditorium of the United States Chamber of Commerce, Washington, D. C., on Wednesday, October 8, 1930. The meeting was called to order at 8:15 P. M. by Mr. Benedict Crowell, President of the Association. A verbatim transcript of the proceedings follows:

MR. CROWELL: "Members of the Army Ordnance Association, members of the Committee on National Defense of the United States Chamber of Commerce and guests:

"I am delighted to have this opportunity as President of the Army Ordnance Association to welcome you to this, the first session of the Twelfth Annual Meeting of our Association. For eleven years it has been customary for us to hold this assembly at the Aberdeen Proving Ground as one of the scheduled events on that program. The Aberdeen tests and demonstrations, which we shall attend as usual tomorrow, have become such an institution and the numbers attending have become so large that we have found it necessary to make a change in our regular procedure and hold our business and technical session here in Washington, leaving the full day at Aberdeen tomorrow for the observation and study of technical and scientific development.

"At the start, I desire to say a word of special welcome to several distinguished groups who are with us this evening. These include the Committee on National Defense of the United States Chamber of Commerce, which is participating in our meeting this year and the Chairman of which, Mr. Trigg, will address you later on in the program. I would like also to extend a special welcome to the Ordnance District Chiefs who are here in Washington for their annual conference with the officials of the War Department, and to the commanding officers of the manufacturing arsenals of the Ordnance Department. We feel highly honored in having these outstanding groups at this gathering.

"Due to the important business to be transacted tonight I will not discuss in detail the affairs of our Association other than to say that our activities under our constitution are being carried on with all possible vigor and that our membership and financial status are sound. I will leave detailed discussion of these and other subjects to the annual report of the Executive Secretary which, as usual, will be published in our journal at the close of the year. I urge your continued interest and coöperation toward a larger, stronger and even more effective organization.

"We are met tonight to consider serious matters and we are honored by the presence of several distinguished speakers whose addresses I am sure you are anxious to hear. The first speaker, the Assistant Secretary of War, is one of our own ordnance family. He served as a commissioned officer in the Ordnance Department during the World War and in later years was Assistant Chief of the Bridgeport Ordnance District. Since this is his first appearance before our Association as the Assistant Secretary I should like to say to him publicly that the Army Ordnance Association to a man was immensely gratified at his selection to the important position he holds and we shall always consider him and his work as an indication of the importance of the Ordnance Department and an honor to our Association. I take pleasure in presenting the Assistant Secretary of War, Col. Frederick H. Payne, who will discuss 'The Control of Industry in War.'" (Colonel Payne's address is published on page 181 of this issue.)

"Thank you, Colonel Payne. Your address was most interesting. Industrial preparedness, as you well know, is the great objective of our organization and you can depend upon our Association—'our first line of munitions reserve'—to coöperate with you and your office in every possible way and at all times.

"Gentlemen, the ordnance scepter has passed to other hands. He who guided the great Ordnance Department so successfully during a major part of the World War and during the intervening time until April of this year, has relinquished his command. General Williams is with us tonight and we will do him honor later on in our program. The responsibility of directing the Ordnance Department has been assigned to another, a capable officer who will meet those responsibilities with the highest degree of efficiency and dispatch. I take pleasure in presenting our new Chief of Ordnance, Maj. Gen. Samuel Hof." (General Hof's address is published on page 183 of this issue.)

"General, we are grateful for your splendid talk. You too know that the Army Ordnance Association desires to work hand in hand with the Ordnance Department. Your plans are our plans and to be of assistance to you and your Department always will be a duty and privilege which our organization is proud to fulfill.

"It is customary for our Association to invite some nation-wide organization to participate in our annual meetings. This year the National Defense Committee of the Chamber of Commerce has accepted our invitation and is joining in our deliberations. The Chairman of the Committee, Mr. Trigg, is one of our speakers. He will outline the important work of his committee and emphasize in particular one of the major industrial defense activities it has sponsored. I am pleased to present Mr. Ernest T. Trigg of Philadelphia, chairman of the Committee." (Mr. Trigg's address is published on page 185 of this issue.)

"Thank you, Mr. Trigg. Our Association has gone on record as to the soundness of educational orders. We too will do everything possible to help in making them an accomplished fact. Your Committee is doing a very important work and we congratulate you on its splendid record of success.

"Gentlemen, General Tschappat is a new Assistant to the Chief of Ordnance. He succeeds our good friend General Ruggles as Chief of the Manufacturing Service. I had hoped until the last moment that General Ruggles would be with us tonight. He is unavoidably away from the city. His loss to the Department through retirement after 44 years of active service is very real and we miss him. Tschappat's 'Ordnance and Gunnery' was a byword during the World War. Those of us who were somewhat unfamiliar with the complexity of ordnance in those days

found General Tschappat's book a veritable bible of seemingly inspired data. General Tschappat will now deliver an illustrated address on the present status of Army Ordnance development.

"I will ask the gentlemen on the platform to take seats in the auditorium so that they can see the pictures. General Tschappat." (General Tschappat's address appears on page 191 of this issue.)

"Your lecture, General, was most interesting and we are all very grateful to you for it."

MR. CROWELL: The next and final event on our program is the foundation and first award of the Williams Medal for Distinguished Ordnance Service. I will ask the following officers and directors of the Association who are present kindly to come forward and take seats on the platform: Colonel Spruance, one of our vice-presidents, and the following directors: General McRoberts of New York, Colonel Harrison of Cincinnati, Colonel Walsh of New York, Colonel Tenney of Springfield, Mass., Colonel Scullin of St. Louis, Mr. Holt of Stockton, Calif., Mr. Dravo of Pittsburgh, and Mr. Jones of Philadelphia. I will now ask Maj. Gen. C. C. Williams to come to the platform.

The Williams Medal for Distinguished Ordnance Service.
(From retouched photographs, actual size. The medal is suspended on the official ribbon of the Army Ordnance Association.)

"The officers and directors of the Association have long felt that the important sphere of ordnance activity is worthy of some signal honor for those who merit distinction in it. This is but to do for munitions engineering what has already been done in practically all the divisions of scientific and technical endeavor. The chemical engineering societies have their honors as do the mechanical, electrical, civil and mining engineers and other professional groups. Strange to say until now ordnance has had no special honor to confer upon those who are worthy of distinction for works of merit in that field. And yet ordnance embraces every kind and type of engineering and indeed is among the most scientific and technical of all pursuits.

"Cognizant of this situation, the officers and directors of our organization have decided to found an award for distinguished ordnance service. A gold medal, to be known as the Williams Medal, will be awarded from time to time for outstanding performance in the field of munitions. Under the regulations which will govern the bestowal of the medal its award in years to come will not be confined to any particular class of individuals nor will it be awarded at stated intervals. We hope it will become an honor of rare distinction.

"It is not necessary for me, I am sure, to tell you from whom the medal gets its name. While it has for its objectives the purposes which I have outlined, it is also to serve as a tribute to an outstanding officer and leader who, in our judgment, has done more than any other single individual for the advancement of American munitions. To attempt to add to the fame and regard which General Williams already holds would be superfluous on our part. In naming the medal for him we are but endeavoring to add our tribute to the superb record which he established as Chief of Ordnance of the Army for twelve years.

"Not only is the medal established in General Williams' name but its first award will be made to him. His long record of service and his preëminent ability as shown through his masterly conduct of the Ordnance Department during the World War and the rapid strides in the development and service of ordnance in the post-war years, in our judgment, have contributed more than any one factor toward a better understanding of the importance of ordnance. As Chief of Ordnance during the trying days of 1918, General Williams led his department in the successful performance of one of the most difficult tasks in our nation's history. After the war he directed his organization in the improvement of weapons and, under his leadership, there were developed types of guns, ammunition, bombs and automotive weapons which represent the highest mechanical application of modern technique and research to our military armament. He was one of the first to sense the importance of industrial preparedness and he has, throughout his post-war career, been a leading exponent of the education of industry to the needs of the national defense. For these reasons, any one of which is good and sufficient in itself, the first award of the medal is made to General Williams.

"General, in the name of the Army Ordnance Association it is my privilege to bestow upon you the Williams Gold Medal for Distinguished Ordnance Service."

GENERAL WILLIAMS: "Mr. President, directors and members of the Army Ordnance Association and guests: I cannot tell you how deeply I appreciate the honor that has been done me this evening. To my mind this beautiful medal is a symbol of a vital part of the work of the Ordnance Department and that is the maintaining throughout the future of intimate contact with industry. In my opinion through that intimate contact we will be able to solve our problems. We must coöperate always with industry as we will need it in time of emergency. Again, may I thank you for the honor you have done me."

MR. CROWELL: "This concludes our program for this evening. Unless there is further business from the floor we will recess to meet again at the Aberdeen Proving Ground tomorrow at 10 A. M. Thank you very much for your attendance and interest. And may I again thank the several speakers for their instructive and inspiring addresses. I venture to say that this has been one of the most significant national defense gatherings in recent years."

EDITOR'S NOTE: The Williams Gold Medal is the design of the eminent sculptor, Mr. Rudd Freund of Philadelphia, Pa. The dies were cast and the medal struck by the Bailey, Banks & Biddle Company of the same city. The medal, in future, will be identical in all details except the engraved name of the recipient in the panel on the reverse side.

Members of the Army Ordnance Association and Guests Observing Test Firings at the Twelfth Annual Meeting.

Our Twelfth Annual Meeting

Part II: The Tests and Demonstrations at Aberdeen

A GLIMPSE of land warfare of the future with mechanized equipment replacing the human machine on the battlefield was given members of the Army Ordnance Association and their guests at the second session of the Twelfth Annual Meeting of the Association at the Aberdeen Proving Ground, Md., October 9, 1930. This was but one feature of an all-day program arranged by the War Department for some 6,000 engineers, industrialists and their guests who attended.

The mimic mechanized battle began with the appearance of observation planes to observe and report upon enemy positions. These were followed by fast armored cars constituting the advance elements of ground forces to locate enemy positions in greater detail and transmit this information to troops in the rear. Next came long-range artillery on self-propelled mounts which opened fire upon targets, followed by the antiaircraft elements whose duty it is to protect the deployment and advance of the ground forces. Following in rapid succession came the light artillery and chemical mortars reinforced by heavier caliber guns which fired in preparation and in support of the attack. Next, medium tanks rushed the principal hostile defensive elements, crushing machine gun nests and attacking antitank guns. This fast tank wave was supported by accompanying artillery. Finally cross-country cars and cargo carriers brought forward the infantry with automatic rifles and machine guns to complete the capture of the position, and the divisional infantry, represented by a war-strength platoon, advanced to and held the position secured by the mechanized force, releasing the latter for further forward movement.

Test Firing the 16-inch Seacoast Gun at the Twelfth Annual Meeting.

Army mechanization and antiaircraft defense occupied the main features of the program which began at 10 A. M. and included many of the current tests regularly carried on at the Proving Ground, while, in addition, other branches of the Army participated in exhibitions of the tactical use of new materials. During the morning, firing tests were conducted using latest types of smokeless and flashless powder and many weapons of recent development in the American service. These included the new 75-mm. infantry mortar, a smooth bore weapon firing a 10-lb. fin-type projectile to a range of about 2,000 yards. The 75-mm. pack howitzer which replaces the 2.95-inch mountain gun in use since the Spanish-American War, and which breaks down into 6-mule loads for transportation, also was fired.

The program also included a demonstration of the new "all-purpose" 75-mm. gun mount described by Major Barnes in this issue of ARMY ORDNANCE. Air Corps tests and demonstrations which included tactical maneuvers by bombardment planes from Langley Field, Va., and observation planes from Mitchel Field, N. Y., were most instructive. The 69th Coast Artillery (A. A.) Regiment demonstrated the remarkable advances made in equipment and training for protection against aircraft attack. Machine guns and the 3-inch and 105-mm. antiaircraft guns with latest fire-control equipment were

used against targets towed by airplanes. The same organization and equipment aided by searchlights and sound locators were used in antiaircraft firings at night.

The Pitcairn-Cierva Autogyro Which Demonstrated Its Possible Defense Use at Aberdeen.

LEADING the great throng of visitors were many individuals prominent in industrial and military affairs. The group of distinguished guests included Hon. Frederick H. Payne, The Assistant Secretary of War; Hon. F. Trubee Davison, Assistant Secretary of War for Aviation; Hon. Benedict Crowell of Cleveland, Ohio, President, Army Ordnance Association and Director of Munitions during the World War; Maj. Gen. C. C. Williams, Ret., former Chief of Ordnance, U. S. Army; Gen. John H. Rice of New York, N. Y., Vice-President, American Machine & Foundry Co.; Maj. Gen. Samuel Hof, Chief of Ordnance, U. S. Army; Brig. Gens. W. H. Tschappat and E. D. Bricker, Assistants to the Chief of Ordnance; Maj. Gen. Edw. A. Kreger, Judge Advocate General of the Army; Maj. Gen. Ewing E. Booth, Assistant Chief of Staff G-4; Maj. Gen. Wm. G. Everson, Chief of Militia Bureau; Maj. Gen. Harry G. Bishop, Chief of Field Artillery; Maj. Gen. Harry L. Gilchrist, Chief, Chemical Warfare Service; Maj. Gen. John W. Gulick, Chief of Coast Artillery, Rear Adm. Wm. D. Leahy, Chief, Bureau of Ordnance, Navy Dept.; Rear Adm. Wm. A. Moffett, Chief, Bureau of Aeronauties, Navy Dept.; Rear Adm. S. S. Robison, Superintendent of Naval Academy, Col. Julian E. Yates, Chief of Chaplains; Col. H. W. Schull, Commanding Officer, Watervliet Arsenal; Col. John Joyes, Commanding Officer, Springfield Armory; Col. T. C. Dickson, Commanding Officer, Watertown Arsenal; Lt. Col. J. E. Munroe, Commanding Officer, Frankford Arsenal; Col. D. M. King, Commanding Officer, Rock Island Arsenal; Maj. J. B. Rose, Commanding Officer, Picatinny Arsenal; the following officers and directors of the Army Ordnance Association: William C. Spruance of Wilmington, Del., Vice-President, E. I. duPont de Nemours & Co.; Samuel McRoberts of New York, N. Y., Chairman, Chatham-Phenix Natl. Bank & Trust Co.; C. L. Harrison of Cincinnati, Ohio, capitalist; James L. Walsh of New York, N. Y., Vice-President, Guardian Detroit Bank; Charles H. Tenney of Springfield, Mass., Chairman Springfield Gas Light Co.; Pliny E. Holt of Stockton, Calif., Director, Caterpillar Tractors, Inc.; R. M. Dravo of Pittsburgh, Pa., President, Dravo Contracting Co.; John C. Jones of Philadelphia, Pa., President, Cochrane Corp.; Harry Scullin, St. Louis, Mo., President Scullin Steel Co. Ordnance District Chiefs in addition to those who are also officials of the Association included Theodore Swann of Birmingham, Ala., Assistant Chief, Birmingham Ordnance District, President, Southern Manganese Corp.; B. A. Franklin of Springfield, Mass., Chief, Bridgeport Ordnance District, President, Strathmore Paper Co.; Ledyard Cogswell of Albany, N. Y., Chief, Buffalo Ordnance District, President, New York State National Bank; F. W. Roller of New York, N. Y., Assistant District Chief, New York Ordnance District; H. A. Gidney of Pittsburgh, Pa., Assistant District Chief, Pittsburgh Ordnance District, Comptroller, Gulf Refining Co.; Frank B. Bell of Pittsburgh, Pa., Assistant District Chief, Pittsburgh Ordnance District, President, Edgewater Steel Co.; W. I. Berryman, Chief, 3rd Procurement District, Chemical Warfare Service; and the members of the National Defense Committee, U. S. Chamber of Commerce.

THE many arrangements connected with the lengthy program and the orderly handling of so many visitors were admirably conducted by the Commanding Officer of the Proving Ground, Lieut. Col. Edward M. Shinkle. Colonel Shinkle left no stone unturned to provide for the comfort of the many guests. Every member of the Proving Ground staff, military and civilian, did his part admirably, and the Association is grateful to all of them as well as to the many officers of the Ordnance Department who were assigned duties at the Proving Ground on Ordnance Day.

Part of the Equipment Which Participated in the Maneuvers of a Mechanized Force at the Aberdeen Meeting.

Training Ordnance Reserve Officers

Courses at Massachusetts Institute of Technology, August, 1930

By Edward F. Miller*

THE Ordnance Department of the Army made use of the teaching staff and of the physical equipment of Leland Stanford University in the training of Ordnance reserve officers during a two weeks' period starting in February, 1930. Twenty-two officers reported for duty; six acting as instructors.

The subjects offered and the enrollment in each subject were: District organization, 5; industrial mobilization, 8; ordnance engineering, 12; gages, 9; ordnance steels (metallurgy), 11; chemistry of explosives, 11; ordnance metallurgy (advanced), 4; pistol practice, 7. Three of the officers who acted as instructors each attended the lectures on one subject.

About the middle of April, 1930, Brig. Gen. C. L'H. Ruggles, then Assistant to the Chief of Ordnance, arranged for a meeting at the Massachusetts Institute of Technology of the chiefs of the various Ordnance Districts in the eastern part of the country with Maj. A. B. Johnson, Personnel Officer of the Ordnance Department, and with Maj. R. H. Somers, Ordnance officer in charge of the R. O. T. C. Ordnance Unit at M. I. T. and with the writer to consider the possibility of offering similar training at M. I. T. Before the meeting a schedule of subjects which might be offered had been drafted in some detail for consideration at the meeting.

Many of the older members of the Faculty at Tech hold commissions as reserve officers in the Army or in the Navy, or are officers in the National Guard. At the present time it appears that out of a total of 425 on the instructing staff 88 hold commissions in the Army, Navy or National Guard. There was little difficulty, therefore, in selecting from this group, reserve officers who were fully qualified to teach such subjects as we had drafted in detail for presentation to the committee.

The committee recommended, subject to the approval of the Chief of Ordnance, that the subjects lettered A to I, inclusive, be made available and that the officers taking active training select some one of the following combinations which were possible without conflict of hours:

SUBJECTS OFFERED IN ORDNANCE

Course A. Military ..... Maj. R. H. Somers
Lecture 8-9 A. M. daily. 1 hr. preparation per lecture
12 hrs. per week

Course B. Inspection and Gages ..... Maj. Earle Buckingham
Lecture 9-10 A. M. daily. 1 hr. preparation
12 hrs. per week

Course C. Production ..... Major Buckingham
Lecture 10-11 A. M. daily. 1 hr. preparation
12 hrs. per week

Course D. Ordnance Engineering ..... Maj. A. F. Holmes
Lecture 11 A. M. to 1 P. M. daily. 3 hrs. preparation for 2 lectures
30 hrs. per week

Course E. Heat Treatment ..... Capt. J. H. Zimmerman
Lecture 9-10 A. M. Mon., Wed. and Fri.,
Laboratory 9-11 A. M. Tues., Thurs. and Sat. 2 hrs. preparation per Lab. Ex.
15 hrs. per week

Course F. Materials of Engineering and Specifications ... Captain Zimmerman
Lecture 11-12 A. M. Mon., Wed. and Fri. 1 hr. preparation per lecture
Laboratory 11-1 P. M. Tues., Thurs. and Sat. 2 hrs. preparation per Lab.
18 hrs. per week

Course G. Metallography ..... Lieut. Col. R. S. Williams
Lecture and Lab. 1:30-5 P. M. except Sat. 1 hr. preparation per day
22.5 hrs. per week

Course H. Explosives ..... Capt. H. W. Underwood, Jr.
Lecture 9-10 A. M. daily. 2 hrs. preparation per lecture
30 hrs. per week

Course I. Design of Powder Plant ..... Maj. C. S. Robinson
Lexture 2-4:15 P. M. daily except Sat. 3 hrs. preparation per lecture
25.75 hrs. per week

POSSIBLE COMBINATIONS

Total Hours per Week for Each Combination

A–B–C–G	58.5	A–E–F	45
A–E–D	57		
H–I	55.75		
A–B–D	54	A–C–F	42
A–C–D	54	A–H	42
A–E–G	49.5	A–D	42
		A–I	37.75
A–C–G	46.5	A–B–C	36
A–B–G	46.5	A–G	34.5

IT is the custom at Technology to rate 50 hours per week of lecture, preparation time in the nature of outside study, laboratory work and the time required in calculating and writing up laboratory reports as a full load for a student. In the Summer Session where intensive courses covering subject matter given in four months of the college year are taught in four weeks, a student is not allowed to carry a load of over fifty hours per week unless the head of the department in which the student is registered states that the student has exceptional ability. As the combinations listed cover a minimum of 34.5 up to a maximum of 58.5 hours per week it is evident that everyone has a sufficient load.

The officers who asked for the detail came with the intention of working hard and they were not disappointed. Two of the officers—a colonel and a lieutenant-colonel—each carried more than 55 hours per week.

A full teaching load in the intensive courses given in the Summer School at M. I. T. is rated as 12 lectures per week or 24 hours of laboratory work per week; two hours of laboratory counting as one hour of lecture where a man has both lecture and laboratory work.

The reserve officers who acted as instructors had in each instance a full teaching load. The staff was as follows: Maj. R. H. Somers, Ord. Dept., U. S. A., detailed to M. I. T. in charge Ordnance Unit R. O. T. C.—Officer in Charge, lecturer in, and responsible for, Course A—Military; Maj. George W. Morse, Medical Director in charge M. I. T. Infirmary, Medical Examiner of Officers; Lieut. Col. R. S. Williams, Course G, Metallography; Maj. A. F. Holmes, Course D, Ordnance Engineering; Maj. C. S. Robinson, Course I, Design of Powder Plant; Maj. Earle Buckingham, Course B, Inspection and Gages, and Course C, Production; Capt. J. H. Zimmerman, Course E, Heat Treatment, and Course F, Materials of Engineering and Specifications; Capt. H. W. Underwood, Jr., Course H, Explosives.

The officers were quartered in one of the Tech dormitories, the charge being $5 per week including everything except board and personal laundry work.

The officers detailed for this training course reported to Major Somers at the Ordnance Room at Tech before 10:30

*Dean of Army Officers, Chairman of Summer Session Committee and in charge of Department of Mechanical Engineering at Massachusetts Institute of Technology. Colonel, Auxilliary Reserve, U. S. Army.

Faculty and Student Reserve Officers in Attendance at Massachusetts Institute of Technology Training Courses, August, 1930.

1st Row (left to right): Maj. George W. Morse, Med. Res., Maj. Clark S. Robinson, Ord. Res.; Col. James F. Monaghan, Ord. Res.; Maj. R. H. Somers, Ord. Dept.; Prof. Edward F. Miller, Lieut. Col. Clarence E. Davies, Ord. Res.; Lieut. Col. Robert S. Williams, Spec. Res.; Maj. Addison F. Holmes, Ord. Res., and Maj. Edward P. King, Ord. Res.

2nd Row: 1st Lieut. Kelsey H. Jewett, Ord. Res.; Maj. Wm. F. Costello, Ord. Res.; Maj. Earle Buckingham, Ord. Res.; Maj. Warren B. Hood, Ord. Res.; Maj. Harry I. Lewis, Ord. Res.; Capt. Claude W. Wright, Ord. Res.; Capt. Henry W. Underwood, Jr., Spec. Res., and 1st Lieut. William H. Bender, Spec. Res.

3rd Row: Capt. Gerald R. Brophy, Spec. Res.; Capt. Harold D. Ashton, Ord. Res.; Capt. Gilbert I. Ross, Ord. Res.; Capt. John H. Zimmerman, Spec. Res.; Capt. Charles F. Becher, Ord. Res.; Capt. Floyd E. Mehrhof, Ord. Res.; Capt. Harold R. Turner, Ord. Res., and Capt. Carroll D. Billmyer, Ord. Res.

4th Row (standing): 1st Lieut. Nicholas R. Wilson, Ord. Res.; 1st Lieut. John H. Egan, Ord. Res.; 1st Lieut. Franklyn C. Lindley, Ord. Res.; 1st Lieut. Alban J. Parker, Ord. Res.; 2nd Lieut. William P. Blake, Ord. Res.; Capt. Victor Wichum, Ord. Res.; 2nd Lieut. Charles E. Geisler, Ord. Res.; 1st Lieut. Edward Gluck, Ord. Res.; 2nd Lieut. C. W. Lepsch, Ord. Res.; 1st Lieut. John F. Drennan, Ord. Res.; 1st Lieut. James D. Milne, Spec. Res.; 1st Lieut. Donald D. Alexander, Ord. Res.; 1st Lieut. William M. Croft, Ord. Res.; 2nd Lieut. Chas. F. Schmid, Ord. Res., and 2nd Lieut. William L. Warner, Ord. Res.

A. M. on Sunday, August 17, 1930. After making a tentative selection of subjects they had opportunity to consult the instructors concerning the preliminary preparation needed for any course. As a result of these consultations there were very few changes made in the registrations for subjects after the work started.

The thirty-nine reserve officers including the instructors who reported for duty divide according to rank thus: Colonel, 1; lieutenant colonels, 2; majors, 8; captains, 12; first lieutenants, 11; second lieutenants, 5; total 39.

The description of the courses as announced by the War Department follows:

Course A — *Major Somers*

Military

8 to 9 A. M. Daily

Army Administration. Functions and organization of the Ordnance Department. Problems which will confront the individual reserve officer when ordered to active duty in a procurement district in an emergency. Presupposes a general acquaintance with War Department and Army organization and some knowledge of military discipline and courtesy—1 hour.

Procurement System. The Ordnance Department procurement system in its broader aspects as applied to the work of a district office—1 hour. By Maj. Roger Taylor.

District Offices. The operation of an Ordnance District office and its contact with the Department and with contractors. By Maj. J. K. Clement.

Property Accounting. The regulations and methods of property accounting as applied to private plants making material for the Ordnance Department—2 hours.

Ordnance Contracts. The practical application of contract law to the legal problems likely to arise in connection with contracts made by the Ordnance Department with industrial firms—4 hours. By Lieut. Col. P. J. O'Shaughnessy.

ONE HOUR OUTSIDE PREPARATION REQUIRED IN CONNECTION WITH EACH LECTURE

Course B — *Major Buckingham*

Ordnance Course in Inspection and Gages

9 to 10 A. M. Daily

Course designed to give all officers an appreciation of the fundamental principles of inspection—namely, that the primary purposes of inspection are first, to prevent mistakes and thus assist in economical production, and second, to accept material which will function properly and render the required service.

I. Reasons for Inspection: Kinds of inspection—visual, comparative, functional; material to be inspected—showing the effect of the material on the kind of inspection employed; points at which inspection occurs—showing necessity for process inspection; process versus acceptance inspection—showing who is responsible for each.

II. Drawings: requirements of good component drawings; methods of dimensioning; responsibilities in preparation of drawings; revisions; tolerances, etc.—what they are, how shown and interpreted, what to do when none are shown; good practice and methods to be followed.

III. Specifications: requirements of specifications; responsibilities, revisions; specifications showing inspection methods, functional tests, etc.; interpretations of specifications; information that should and should not be included.

IV. The Inspector: personal qualifications and characteristics; training and experience necessary, knowledge of materials; judgment versus specifications—when and when not to use; responsibility of inspector to Government and to manufacturing plant; personal conduct of inspector.

V. Tools of Inspection; physical measurement; standard units of measure—necessity for and how derived; general description of line standards, micrometers, vernier, standard plug; ring, thread gages, gaging fixtures, etc., showing uses of each, range of accuracy, and application to material; effect of personal equation in using various kinds of "tools."

VI. Inspection Methods: general principles affecting the selection of a suitable method of inspection; what defects can and cannot be discovered by mechanical inspection; necessity for functional tests.

VII. Inspection Organization: relation of inspection to design and production and other administrative functions; division of authority and responsibility; responsibility in getting and using gages and inspection equipment.

VIII. Gages and Interchangeability: why gages are necessary; classification of gages as to use and type; accuracy—what it is and what it means; gage drawings versus component drawings; gage tolerances and wear allowances—what they are and why.

IX. Snap, Plug and Ring Gages: description and uses, showing principally the characteristics of the gage and what dimensions it can measure, when it should be checked and how, and when it should be taken out of service. Commercial standards for these gages.

X. Thread Gages and Inspection: kinds of thread gages, thread comparators, wire measurement, etc. Commercial standards for these gages.

XI. Special Gages: flush pin, contour, sliding bar, profile, indicator, etc., including special gaging fixtures—uses and limitations of each—methods of checking.

XII. Gage Inspection: equipment necessary and care to be taken: points to be inspected in various types; judgment of a gage inspector; uses of measuring machine, super-micrometer, sine bar, gage blocks, comparator, etc.

PREPARATION—A FAMILIARITY WITH MANUFACTURING PROCESSES. ONE HOUR OUTSIDE PREPARATION REQUIRED FOR LECTURE.

Course C *Major Buckingham*

Ordnance Course in Production Methods

10 to 11 A. M. Daily

A study of the production methods used by leading industries, illustrated by slides and moving pictures. The analysis and classification of the various methods of forming and shaping of metals, and their application to the production problems involved in the manufacture of electrical machinery, pipe, pipe fittings, firearms, agricultural machinery, automotive construction, etc.

Preparation required—A familiarity with modern shop practice.

ONE HOUR OUTSIDE PREPARATION PER LECTURE.

Course D *Major Holmes*

Ordnance Engineering for Reserve Officers

11 to 1 P. M. Daily

Review of Mechanics: stress and strain relations; relation between modulus of elasticity and modulus of rigidity, also equations of equilibrium; thick hollow cylinder (arranging special formulae for use in ordnance and drawing stress curves when subjected to external and to internal pressure); discussion of compounding and method of figuring shrinkage; formulae for compounding and their application to figuring a force fit, calculations for the two part gun, and method of calculating a recoil mechanism.

THREE HOURS OUTSIDE PREPARATION FOR EACH TWO-HOUR LECTURE.

Course E *Captain Zimmerman*

Industrial Heat Treatment

Lecture—9 to 10 A. M., Monday, Wednesday and Friday.

Laboratory—9 to 11 A. M., Tuesday, Thursday & Saturday.

A course dealing with the fundamental principles of industrial heat treatment as applied to iron, steel and nonferrous alloys. Six one-hour lectures and six two-hour exercises in the Heat Treatment Laboratory alternating as follows:

1. Lecture: The Iron-Carbon System.

2. Laboratory: Demonstrations of the thermal, volumetric and magnetic changes in steel when it is heated through the critical range and of the significance of the critical temperatures with respect to hardness and grain size.

3. Lecture: Heat treatment and physical properties of the carbon steels.

4. Laboratory: Study of the effects of variation of the quenching temperature and of the cooling rate on the hardness and grain size of carbon steel.

5. Lecture: Discussion of hardness and cold work.

6. Laboratory: Study of the effects of cold work and annealing on the hardness and grain size of cartridge brass.

7. Lecture: Discussion of annealing, normalizing, hardening and tempering practices as applied to carbon and alloy steels and to certain nonferrous alloys.

8. Laboratory: Study of the effect of variation of the tempering temperature on the physical properties of hardened 0.50 per cent C. steel.

9. Lecture: Principles and methods of case hardening.

10. Laboratory: Study of the heat treatment of case hardened parts.

11. Lecture: Tool steels.

12. Laboratory: Heat treatment of carbon and high speed tool steels.

This course deals strictly with the fundamental principles of engineering heat treatment and does not depend on any appreciable previous training in the technology of metals on the part of the enrolled officers.

THE TIME ALLOTTED FOR OUTSIDE PREPARATION SHOULD BE TWO HOURS PER LABORATORY PERIOD.

Course F *Captain Zimmerman*

Materials of Engineering and Specifications

Lecture—11 to 12 A. M., Monday, Wednesday and Friday.

Laboratory—11 to 1 P. M., Tuesday, Thursday & Saturday.

A course dealing with the physical properties and testing of engineering materials, and with the interpretation and significance of government materials specifications. Consists of six one-hour lectures and six two-hour exercises in the Testing Materials Laboratory alternating as follows:

1. Lecture: The physical properties specifications, and testing of metals.

2. Laboratory: Demonstration of tensile testing methods. Tests of low carbon steel and cast iron.

3. Lecture: The nonferrous alloys, aluminum alloys, copper alloys, nickel alloys; bearing metals and specifications.

4. Laboratory: Tensile tests of nonferrous alloys.

5. Lecture: The iron-carbon system. The cast ferrous alloys.

6. Laboratory: Hardness tests of metals.

7. Lecture: The carbon and alloy steels.

8. Laboratory: Torsion tests of steel. The carbon steels.

9. Lecture: Discussion of repeated stress, high and low temperature effects, and corrosion.

10. Laboratory: Compression tests of materials of construction. The alloy steels.

11. Lecture: Non-metallic engineering materials and specifications.

12. Laboratory: Transverse test of timber.

No previous technical training required for this course.

Hours of Outside Preparation Are One Hour Per Lecture and Two Hours Per Laboratory Exercise.

Course G *Lieutenant Colonel Williams*

Metallography

Lecture and Laboratory—1:30 to 5 P. M. Daily Except Saturday.

A course of 12 lectures and 24 laboratory exercises dealing with the structure and properties of the important nonferrous alloys; brass, bronze, aluminum alloys, bearing metals and the like. Followed by a discussion of iron and steel with special reference to the alloy steels. The laboratories give opportunity for the micro-examination of alloys and their commercial heat treatment.

Preparation required—a knowledge of inorganic chemistry as given in first year of college curriculum.

One Hour of Outside Study Required for Each Lecture.

No Outside Study Required for the Laboratory Work.

Course H *Captain Underwood*

Military Explosives.

Lecture—9 to 10 A. M. Daily.

Laboratory—10 to 12 A. M. Daily.

The lectures deal with the history, manufacture, composition, properties, manner of use, and methods of testing of the various types of propellants. Initiators and commercial and military high explosives are similarly discussed. The chemical reactions of the compounds used and the current theories of explosives are emphasized. Among the other topics studied are heats of formation, combustion, and explosion. Representative publications on explosives are briefly described.

In the laboratory course nitrocellulose, picric acid, trinitroluene, and nitroguanidine are prepared, and analyses of black powder and smokeless powder and heat tests are performed. Practice in the use of a nitrometer is given. The experiments are designed to give familiarity with the chemical and physical properties of explosives and with methods by which these properties are examined.

The prerequisites for this subject are a comprehensive lecture and laboratory course in general chemistry and a course of at least thirty lectures and sixty hours of laboratory work in organic chemistry.

Two Hours of Outside Study Required for Each Lecture Period.

Course I *Major Robinson*

Design of a Plant for the Manufacture of Smokeless Powder

A course consisting of the following lectures: 1. Chemistry of nitrocellulose smokeless powder; 2. colloidal properties of powder; 3. raw materials; 4. preparation of cellulose; 5. nitration; 6. purification of nitrocellulose; 7. manufacture of ether; 8. colloiding of powder; 9. graining; 10. drying of powder; 11. solvent recovery; 12. selection of plant location and plant layout. Preparation needed—calculus, two years of college physics, and one year of college chemistry.

Outside Preparation Three Hours Per Lecture.

The question which at once comes up in one's mind is whether an ordnance officer profits more by two weeks' active duty at an arsenal or by two weeks of additional technical training at a college.

A number of officers who were in the detail and who had in the past been detailed to an arsenal, without hesitation said that they would recommend the technical training for one or more periods of active duty. The number of officers who wanted this type of training was greater than the funds available would permit. This accounts for the enrollment of only 39.

It would seem that reserve officer training of this character would be most advantageous for a great many reservists not only of the Ordnance Department but of the other branches and services as well, particularly those of the technical departments. Courses of this type conducted at our scientific schools would be equally advantageous for reserve officers of such branches as the Corps of Engineers. Indeed all technical services of the Army might profitably adopt them as part of the active duty training of the civilian component.

Many reserve officers of the Ordnance Department are not likely to have contact with troops—they are the mechanical engineers, the production men, the designers, the manufacturers—and consequently any added technical training such men may get is a direct asset to the Government in an emergency and to the man himself in his daily work.

ARMY ORDNANCE

Published Bimonthly by
THE ARMY ORDNANCE ASSOCIATION
WASHINGTON, D. C.

NOVEMBER-DECEMBER, 1930

Month by Month

AT the Business and Technical Session of the Twelfth Annual Meeting of the Association, October 8, 1930, the following report was submitted by Mr. A. Y. Leech, Jr., Chairman of the Committee of Tellers of Election:

Election of Officers and Directors

"The Tellers of Election of Officers appointed by the President in accordance with Section 23 of the By-Laws of the Army Ordnance Association canvassed the ballots cast for the election of officers and report the practically unanimous reëlection of the following:

President—to serve two years beginning January 1, 1931—Benedict Crowell of Cleveland, Ohio.

Vice-Presidents—to serve two years beginning January 1, 1931—William W. Coleman of Milwaukee, Wis., and William C. Spruance of Wilmington, Del.

For Directors—to serve four years beginning January 1, 1931—Samuel McRoberts of New York, N. Y.; Pliny E. Holt of Stockton, Calif., and Maj. Gen. C. C. Williams of East Hamilton, Mass.

General McRoberts and Mr. Holt have served on our directorate since the founding of the Association and General Williams was nominated to fill the vacancy caused by the death of Mr. Waldo C. Bryant of Bridgeport, Conn.

The report is signed by the members of the Committee who, in addition to myself, were Capt. John K. Christmas and Mr. Colin E. McRae."

As Mr. Leech points out, all officers were reëlected except in the case of General Williams who will serve as an official of the Association for the first time.

The reëlection of these gentlemen and the election of General Williams is a fitting tribute to the splendid work they have been doing these many years for the promotion of munitions preparedness in America. Few organizations can point to such a record of service. The marked progress of the Association, its present strength of membership and sane activity in a field that might easily stray from the paths of sound policy are directly attributable to the constant interest and direction of the officers and directors. We are confident that the result of the election bespeaks the thanks of the entire membership and the reliance that, under their continued guidance, the organization will maintain its steady progress toward its all-important goal.

IN a recent lecture before the student officers of the Army Industrial College, Maj. Gen. John L. DeWitt, Quartermaster General of the Army, emphasized the essential requirement for unity of control of the military and industrial operations of the defense services in peace for their coördinated and efficient conduct in war. The Office of The Assistant Secretary of War, as established by the National Defense Act of 1920, is the agency for supervising that coördination. Its industrial planning and control activities and the present state of efficiency now obtaining in the procurement phases of defense are an echo of the soundness of the ideas upon which the provisions of the Act were based.

Unity of Control

General DeWitt demonstrated this in his reference to the paper prepared by General Dawes in 1918 as the result of his experience as General Purchasing Agent of the A. E. F. The Dawes observations and recommendations for overcoming the ills of those days are historic and deserve a wider acquaintance. The following quotation, cited by General DeWitt, is in point:

"The current criticism of Army organization is based largely upon the assumption that it ignores certain fundamental principles of normal business organization, which should be applied to the business system of an army, notwithstanding that the ultimate purpose of an army's existence is military, as distinguished from business, success. The conventional view of the Army purchase and supply system, held by the non-military business man, is that the system of independent departmental purchase is a failure, because, while it is susceptible to an outside coördinating control, this control is not accomplished, as in the normal business organization, by a complete centralization of purchase and supply through one agency acting for the Army as a whole. The argument of the business man is that if all purchasing and supply activities were centralized in one distinct Army department, created to supply all other branches of the service, there would be obviated competition among the various departments, piecemeal and wasteful purchases, loose methods, insufficient estimation of forward collective needs, and many other objections now incident to some extent to the present system. It is contended that the needs of an army and their satisfaction will be better ascertained and accomplished by a central body, having always the bird's-eye view of the situation, and that equally satisfactory results will not be incident to any method of central control reached through a coördination of independent agencies. It was with this belief that I took up my duties as General Purchasing Agent of the American Expeditionary Force. * * *

"* * * My idea, as that of many other business men, had been that the laws of the United States which so jealously guarded the independent right of purchase and supply in departments of the service, was on our statute books as a result of a lack of business knowledge and foresight on the part of legislators, instead of its being as it is, the logical, legitimate and necessary evolution of thousands of years of actual military experience. Now, after six months in time of war, in a peculiar position relative to Army purchase and supply activities such as does not exist in the British, French or other army, so far as I know, I am prepared to say that any change in legislation or War Department regulation designed to bring the organization of Army purchase and supply more nearly into accord with the principles of

modern business organization, should provide an agency of supervising coördination, which, while it will permit the application of rigid business principles under normal conditions, will not take away from independent departments the right of purchase and supply, especially during the time of actual military activity, the preservation of such independent powers being absolutely essential at times to military success, which of course is the ultimate object of the whole system."

Unity of control in the Office of the Assistant Secretary of War with independence of delegated power in the several supply branches of the Army is the outgrowth of the failure of older methods. The present organization, conforming with modern practice indicates, as one must conclude from the address of the Assistant Secretary before the members of the Army Ordnance Association published in this issue, that the best thought of our war experience is translated into established policy.

Industrial Mobilization in Germany

THE very informative discussion by Capt. Walter Warlimont of the German Army, which was published in the September-October issue of this Journal, created a great deal of favorable comment among our readers. It contained a clear exposition of the organization of German industrial strength prior to and during the World War and presented an enlightened study of conditions which should be instructive to everyone interested in the broader phases of the general subject.

Among the many comments received, one called attention to the illustrations which accompanied the text. These, it will be remembered, included charts showing the organization of the Prussian War Ministry in 1914, the German Supply Department in 1917, and the German Munitions Division in the same year. Also were published photographs of scenes showing captured German matériel. These latter were not supplied by Captain Warlimont but were selected and published by the Editor. While at the time we attached no important significance to them, we desire, in justice to the author, to acknowledge that they were not contributed by him. Neither was their use intended to reflect in any way upon the cogency of the text. The past has only its valued lessons to record and none of these is more striking than that good will, coöperation and reasonable measures of defense are the surest roads to continued peace. Anyone who may have drawn other conclusions from the editorial treatment of Captain Warlimont's excellent discussion attributes a more serious motive to what, in fact, was intended to be a minor detail.

Sir Philip Gibbs Moralizes

ARMISTICE DAY brings with it each year not only its tributes of grateful peoples to their heroic dead, and their often equally heroic living veterans, of the World War but its platitudes and plaudits for or against the necessity for national defense. Not all that the "never again" contingent hopes for is vain nor is the entire decalogue of the militarist without some gleanings of sensibleness. Both extremes, as is the way of all extremists, have some of the true and some of the false in their preachments. The clear-headed individual has no difficulty in separating the chaff from the wheat, if such a bucolic metaphor can be used to indicate the process of segregation. Insofar as the one extreme is based on hope and the other on faith, possibly he who listens to both with charity chooses the wiser course.

Along with many others who are qualified to speak with knowledge and fitting sentiment on the significance of Armistice Day, twelve years after the guns ceased firing and the war to end war came to a halt, Sir Philip Gibbs, the eminent English war correspondent, drew a pen picture of things as he sees them. With no thought of preaching a war scare we quote the following from Sir Philip's article in *The New York Times:*

"And yet on this twelfth anniversary of the armistice in the two minutes' silence of remembrance, those words 'Never again' come back only as a faint echo. Uneasily, men are asking a question in their own souls even if it does not pass their lips—'How long before the next war?' Militarism has not been dethroned according to the promise. Nations are arming again. Old hates are reviving. Old fears have come back. Not all the peace pacts give a sense of security. Youth, to whom the war is only known by what they read in books or see in the cinema, are not afraid of its grim adventure. To some of them it has a lure as the greatest of all adventures. And some of the world's leaders are playing with fire still smoldering in the passions of that underworld which is the brutality of human nature.

"On the twelfth anniversary of an armistice which silenced the guns in a world war peace has not yet been made. It is still only an armistice."

It is easy enough to snicker at such a conclusion. The thoughtful reader, however, will not treat it quite so lightly. A thinker of the Gibbs' stature is competent to appraise the matter and to point a moral which, by inference, we are justified in drawing. And that is, a reasonable degree of preparedness for national defense is required as much today as it was on November 12, 1918, more than it was on August 12, 1898, much more than it was on April 9, 1865. And by reasonable is meant just that. Not huge armies and navies, not great aggregations of professional soldiers, not vast reserves of munitions. Surely the American system of national defense can not be said to overstep the bounds of prudence in any of these respects. Indeed, in certain of them we are now, and, judging from the past, will always be deficient. Reasonable preparedness in manpower we have; in munitions power we are endeavoring, through coöperation and education, to attain the required status. And in neither of these respects can it be said that there is the slightest trace of the man "who goeth about armed" but rather of him who would be called peacemaker. The present armistice, to which Sir Philip alludes, if it is only that, may it gradually resolve itself into the permanent peace of universal desire.

Paradoxical though it seem, the father of political economy as a practical science, Adam Smith, might write today as he did in his *Wealth of Nations* in 1776:

"In modern war the great expense of firearms gives an evident advantage to the nation which can best afford that expense; and consequently, to an opulent and civilized, over a poor and barbarous nation. In ancient times the opulent and civilized found it difficult to defend themselves against

the poor and barbarous nation. In modern times the poor and barbarous find it difficult to defend themselves against the opulent and civilized. The invention of firearms, an invention which at first sight appears to be so pernicious, is certainly favorable both to the permanency and to the extension of civilization."

The invention of "firearms" and the ability to make and use them for defense are precautionary precepts in which we of today must be proficient always if Gibbs' twelve-year armistice is to be lengthened until the barbicans of the modern gate of Janus are closed forevermore.

Congratulations and Thanks

OCTOBER is the banner month in the annual cycle of ordnance activities. As a result of custom, accumulating from year to year, it has become the period when conferences and meetings of serious import to ordnance progress are held. We believe that the custom started with the holding of the annual meeting of the Army Ordnance Association in October, and when the annual conferences of Ordnance District Chiefs became established procedure they were scheduled to be held in Washington preceding the meeting of the Association. In addition, it has become customary for the officers of the Ordnance Department who are assigned as executive assistants to the Ordnance District Chiefs to assemble for conferences relative to the progress of their work. More recently, the commanding officers of the manufacturing arsenals have been included in the discussions so that now there is a very pretentious schedule of official gatherings immediately preceding the Association's sessions.

These official conferences as a part of the annual October program are of most serious import. Not only do they show a very keen desire on the part of the Chief of Ordnance and his staff in Washington to keep in close touch with field operations but they offer for all concerned a convenient forum for the discussion of mutual problems and the presentation of a complete picture of the industrial planning activities of the department. We congratulate all who take part in this very serious business. From year to year the interest and effort of the civilian district chiefs becomes even more active and important. This group of individuals is carrying on a work which some day may exceed in importance every other defence activity. That the arsenal commanders—they who are charged with the limited current manufacture for Army needs as well as with the estimation of the proper place their respective establishments will occupy on a war basis, even though that place may be a quantitatively minor one when huge requirements are to be met—have a definite place in the general scheme of industrial war planning is both a logical and necessary expedient.

Based on the results of this year's discussions and reports of progress very creditable and efficient advancement has been made in each appointed task.

As to the place of the Association's activities in the October program, time seems to have decreed their great importance. This year they were even more elaborate than heretofore. With the foundation and award of the Williams Medal at the first session of the Twelfth Annual Meeting of the Association there was an atmosphere of interest which we attribute as well to General Williams, the central figure of the evening's program, as to the important papers presented by distinguished speakers. Preceding the business and technical session a dinner was given by Mr. Crowell, President of the Association, in compliment to General Williams at which a notable assembly was present. In addition to the officers and directors of the Association, the chiefs of the Ordnance Districts and the commanding officers of manufacturing arsenals, there were present those leaders of our American war effort, Maj. Gen. James G. Harbord, Ret., former Chief of Staff of the Army, commander of the famous Second Division and Chief of the Services of Supply, A. E. F., and Brig. Gen. John H. Rice, Ret., Chief Ordnance Officer, A. E. F.

As for the Aberdeen session of the Twelfth Annual Meeting, only highest praise can be accorded the Ordnance Department and other branches of the Army which participated in the program. The Aberdeen meeting has become such an institution that we are prone to look upon it as a matter of course. It means a great deal of effort and planning, particularly for the Commanding Officer of the Aberdeen Proving Ground and his staff. While all the tests are on approved programs, work which would be done at the Proving Ground regularly, the mere accommodation and handling of the large crowds which attend demands that every possible precaution for safety and convenience be adopted. Each year the authorities at the Proving Ground perform their task in better fashion than the year before so that the Twelfth Annual Meeting, with several innovations looking toward the greater convenience of members, was in the judgment of many the best in the long series of meetings to date. Our thanks and congratulations to the entire Ordnance Department and particularly to Lt. Col. Edward M. Shinkle, Commanding Officer of the Proving Ground, and his staff, military and civilian.

This year several departures were inaugurated with respect to the Association meeting. In former years the business and technical session for the discussion of ordnance progress was held at the proving ground. The program of tests and demonstrations there, already sufficiently long to occupy the entire day, left insufficient time for a representative session of this character. Consequently the business and technical session was held for the first time in Washington independently of the Aberdeen session. Judging from favorable comment received the change is worthy of adoption as a permanent plan.

Among other changes put into effect, those relating to the admittance of guests at the proving ground, special reserved sections for members of the Association and the service of meals were experimental in that further study must be given these very necessary matters until a practicable arrangement can be determined upon.

All in all, October days are ordnance days. They concentrate nation-wide thought on a vital national subject. They are days of study, discussion and planning. They are chronological rungs in the ladder of ascent of a munitions-minded group who are giving the required impetus to a people less munitions-minded. Thanks to them, each October will witness greater things and a growing purpose.

If just a little of present thought and effort had been devoted to these subjects in former years the problem need not now be so pressing. May the good work continue.

A Step Forward in Industrial War Planning

An Editorial

DIFFICULTIES encountered during the World War in furnishing the Army with the enormous amounts of munitions required for a modern war gave the impetus to the materialization of industrial war plans in time of peace. After the Congress granted the necessary legal authority for industrial preparedness, the plans were gotten under way in 1921. They were based largely upon the specialized experience of the World War, the feature of which was that the Allies carried on the war while we got into production.

A governmental policy of the magnitude of industrial preparedness is naturally slow in evolution. There are many men and many conditions to meet, the background is waning from year to year, as the business given by the War Department to industry is decreasing. Nevertheless, the first decade of industrial war planning has been immensely useful in acquainting both the War Department and industry with the magnitude of the problem involved, in setting up the organization and training the necessary special personnel. As a result of this experience there has been crystallized, in the minds of those particularly interested in this subject, the necessity for a basic plan of action suited to our industrial organization and the peculiar nature of our military forces.

THAT part of the plan to give a more accurate survey of the plants suitable for Ordnance production has now been fairly worked out and presented to the Ordnance Department by Capt. Walter Soderholm, Ord. Dept., U. S. Army, who has been for almost five years the executive assistant in the Chicago District Ordnance Office. That the procedure developed by Captain Soderholm, and described by him in his article in this issue, is a successful meeting of the various viewpoints involved was shown by the almost unanimous approval accorded his plan when it was presented at a meeting of arsenal commanders, civilian district chiefs (representing industry) and district executives in Washington during October. The Chief of Ordnance had previously given his approval and directed that the paper be presented at the annual conference on industrial war planning. The plan proposed is simple, flexible and logical; indeed it places the burden of initial industrial war planning on the military organization in a form in which it can be readily utilized. The most important advantage of the new plan is that by the use of all *existing* industrial facilities, it will do a great deal to solve the biggest question of all: where to get *early* production of munitions.

Early production of ordnance in time of war with all its vital consequences depends more on a unified system of planning approach than upon any other factor. That is to say, a system of such magnitude and of such seriousness demands a common denominator in application and this is what the Soderholm plan proposes. It offers the substitution of the particular for the general. It aims to remove the guesswork from basic considerations of defense and to replace uncertainty with definite and dependable accuracy. These results, we gather from the Soderholm paper, are to be accomplished by the translation of ordnance war-time requirements into machine hours of available equipment. A gigantic production job is tackled in terms of production engineering. This is as it should be.

INDUSTRIAL planning for war having been placed on the sure footing of an approved policy of defense it is time to deliniate our requirements in machine hours for the benefit of industry, of the Government officials and of the national defense. For industry the burden of much time-consuming detail and study will be greatly reduced. While the factory plan will always be necessary and the same high degree of military and industrial coöperation will be needed, the computation of capacities and schedules will be simpler with less expensive demand on engineering personnel in time and study. For the officials of the procurement agencies charged with making the surveys and the placing of war orders, the uncertainty of judging the correctness of capacities and schedules will be removed and changing requirements will be far more flexible. Surely both agencies will gain by the transition and it follows that the national defense is made firmer at both ends with the result that one of its principal elements—industrial preparedness—becomes closer advanced to the field of fact and further removed from the field of theory.

Lest the impression gain currency that the adoption of this system will in any wise lessen the importance of the manufacturer in the perfection of procurement planning it might be well to emphasize again that such is not the case. Captain Soderholm suggests nothing which will lessen one whit the place of industry in national defense. Under his plan the same close coöperation will be essential. He does suggest the use of a measuring stick to prevent delays and uncertainties so that the plant executive need not spend so many hours in fitting ordnance to the machines of peace-time industry and, concomitantly, no longer need the district offices and the Ordnance Department wonder whether the plant surveyed really can do its expected job.

FOR all that, the Esparanto of machine hours has its pitfalls not in theory but in application. Unless it is undertaken systematically and whole-heartedly from the ground up, or from the roof down as you will, it can be butchered easily. Captain Soderholm has applied his scheme to an actual case—a simple one it is true. Production men have placed their stamp of approval on the proposal, district chiefs and arsenal commanders see in it an advantageous step forward. It is to be hoped that it will be tried on a nation-wide scale; if there are any kinks they can be ironed out and the entire system may be modified accordingly. This done we have every confidence that Captain Soderholm has made a real contribution to the national defense. His scheme, tolerantly applied, will remove the dust from industrial preparedness and will keep clear an atmosphere in which befogged traditions might easily accumulate. And who shall gain-say the truism that a blurred perspective, much less guesswork, has no place where "our lives, our fortunes and our sacred honor" may some day be at stake?

AOA

Professional Notes

France to Test Automatic Guns

AS in the case of the competitive tests conducted last year by the War Department for the selection of a semi-automatic shoulder rifle for the American service, word is received from France that the Minister of War has decided to open a competitive match for automatic guns looking toward the ultimate adoption of an arm for use in the French Army. The competition will be open until March 1, 1931.

According to an announcement, two specimens of each arm should be presented to the General Inspector of the French Army for study and technical test before the above date. The weight of the arm should not exceed 4 kg. without the bayonet, the maximum length should be 1.1-m. without the bayonet, the barrel having a length in principle of 0.6-m. with the chamber included. The caliber may vary from 7 to 8-mm. and its power should be comparable to that of the Mauser 7.9-mm. The weapon should be strong so as to be easily carried in a shoulder belt and offer good protection against mud and exterior agents. The method of disassembling the arm should be simple and its fire accurate.

The tests will consist principally of: (a) In an elimentary proof from end to end without cleaning comprising five successive shots, 100 cartridges each, separated one from the other by cooling of the barrel with water and made at the rate of 15 shots a minute; (b) in a succession of shots from 50 to 100 cartridges separated by the time necessary for the cooling of the arm by air or water and done as much as possible without cleaning until the arm ceases to function. The accuracy as well as the correctness of the line of sight shall be checked periodically when the arm is hot and cold in the course of the firing.

The 1930 Antiaircraft Exercises

THE fifth of an annual series started in 1926, the Army's antiaircraft exercises for 1930 began August 15th at the Aberdeen Proving Ground, Md.

The rapid development of aviation has made necessary an intensive effort by Army authorities to provide an adequate ground defense of Army installations and important localities against hostile air attack, in addition to the defense provided by our own air forces. The guns, machine-guns, fire-control instruments, searchlights and sound locators which embody all the latest improvements made by the Ordnance Department were assembled at its proving ground at Aberdeen for test. The Coast Artillery provided one of the four antiaircraft regiments now stationed in the United States to man and fire the new equipment. Upon the conclusion of the exercises this year, three of these four regiments will have had the valuable experience to be derived from these extensive firings. The 69th Coast Artillery (A. A.) which was organized at the Aberdeen Proving Ground, February 1, 1930, and commanded by Lieut. Col. James B. Taylor, C. A. C., was assigned to fire the tests. The Air Corps coöperated and gave essential assistance by providing pilots and planes equipped to tow targets through the air, not only in the day but at night as well. These duties also afford information to our aviators as to new methods of attack and defense against enemy antiaircraft. Maj. John N. Reynolds, A. C., was in command of the air forces at Aberdeen this year. All activities were coördinated and commanded by the Commanding Officer of the Proving Ground, Lieut. Col. Edward M. Shinkle, Ord. Dept.

The test firings continued until the latter part of October. The first two weeks were devoted to functional tests designed to determine whether the new equipment operated as intended and to the training of gunners and instrument operators in their new duties. After this preliminary work, extensive tests were held under conditions approaching those of war in so far as safety considerations and the taking of records permits.

The results of all tests and firings are carefully recorded. For the larger guns a complete record is obtained for every shot fired. These records are studied by experts and help to form a basis for still further improvements.

During the tests three new antiaircraft directors were used. Two of these machines were manufactured in Europe, while the third was designed and produced in this country.

The antiaircraft director is an elaborate and complicated computing machine, which when sighted at the target determines automatically the range and direction at which the guns must be pointed in order that the projectile and enemy airplane will reach the same point in space at the same instant. At ordinary firing ranges of four to five miles, the airplane would travel about 1,500 feet during the interval of time corresponding to the flight of the projectile from the gun. The antiaircraft director must determine continuously and without loss of time the point in advance of the target at which the guns must be aimed, and the effect of all extraneous conditions on the flight of the projectile. It is very properly regarded as the heart of the modern antiaircraft defense system.

The development of the new Ordnance Department director was started at Frankford Arsenal in 1924, and has been continuously in progress since that time. Each year has witnessed important changes and improvements, the value of which have been proved conclusively in the annual firing tests at the Aberdeen Proving Ground. It is expected that the present model will prove to be more efficient than any of the previous types.

In this connection recent experiments by the Signal Corps and the office of the Chief of Infantry in the use of moving pictures for antiaircraft subcaliber practice were put to practical test during the National Rifle Matches at Camp Perry, Ohio, during the past summer. With the coöperation of the Chief of Air Corps, the Signal Corps has made motion pictures of low-flying planes simulating the tactics of attack planes. They are depicted moving across the screen, hedge hopping, diving and moving at various angles to the spectator.

These pictures are projected on an opaque screen made of target cloth and a dull white wrapping paper. Behind this screen several lights are so arranged as to permit the light to penetrate through a puncture in the screen made by the strike of a bullet. Using noninflammable film projected by a portable projector the picture can be stopped the instant a shot has been fired and the projected image held stationary on the screen. In this manner a record of

the strike and its relation to the moving target may be made and the puncture repaired by means of gummed stickers.

Preliminary tests indicate that this will prove to be a very efficacious method of instruction in antiaircraft firing. Numerous improvised targets are used for this purpose but it is believed that a target having the exact outline of an airplane and flying at speeds and angles common to attack planes will be a decided improvement over any existing type used in preliminary training.

Air-cooled Machine Guns Increase Fire Power of Cavalry

ON the recommendation of the Chief of Cavalry, the War Department has approved the replacing of machine rifles, in each troop of cavalry and cavalry trains, by air-cooled machine guns. These will shortly be issued to cavalry regiments. Due to the fact that the machine guns deliver full automatic fire, they are far more formidable weapons than the machine rifles which are fired semiautomatically. When this change is made, the fire power of a cavalry regiment will be greatly augmented. In fact, each war strength regiment of cavalry will possess the dismounted fire power of 16 water-cooled caliber .30 machine guns and 48 air-cooled caliber .30 machine guns, or a total of 64 machine guns plus the fire of 624 rifles.

Machine guns with the cavalry are carried on pack horses, from the backs of which the guns may be removed and firing commenced within 30 seconds from the time horses are brought to a halt. These pack horses can easily keep up with the other cavalry troops, and move rapidly over any kind of ground.

American cavalry has since the Civil War always combined mobility with fire power. Now, with the adoption of the additional machine guns and the new armored cars, it receives a tremendous increase in fire power which will enable it to strike, not only quickly, but with telling effect, in any kind of country with or without roads, in any weather, day or night.

New Antiaircraft Sight for Machine Guns

AFTER two years of experiment and development, tentative regulations governing Infantry antiaircraft machine-gun training methods have been issued to twelve Infantry regiments for exhaustive tests and recommendations as to their efficiency.

During two years' study of the subject, it has been necessary to develop an antiaircraft sight and also an adapter for the machine gun which would enable a gunner quickly to lay his gun on a low-flying aerial target, and then permit his following the target in its flight.

The antiaircraft sight being used at present was developed at the Infantry School, Fort Benning, Georgia, by two Infantry officers—Major Leonard R. Boyd, of Lebanon, Oregon, and 1st Lieutenant Joseph I. Greene, of Daytona Beach, Florida, and is known as the Boyd-Greene sight. It is simply constructed and is apparently rugged enough to withstand service in the field. These sights also have been issued to the twelve regiments to be tested with the tentative regulations.

Prize Competition for Arc Welding

THE Second Lincoln Arc Welding Prize Competition offers engineers and designers substantial rewards for their skill and ingenuity in utilizing the advantages of arc welding in the redesign of any present product or in the design of any proposed product or structure. For the forty-one best papers describing this work $17,500.00 will be awarded by The Lincoln Electric Company, Cleveland, Ohio, as follows: for the first prize paper, $7,500.00; second, $3,500.00; third, $1,500.00; fourth, $750.00; fifth, $500.00; sixth, $250.00; for seventh to forty-first prize papers, $100.00 each.

The Jury of Awards, who will judge the papers entered in this competition, will be composed of the faculty members of the Electrical Engineering Department of Ohio State University under the chairmanship of Prof. Erwin E. Dreese, head of the department, and such others as he may select.

The purpose of the Second Lincoln Arc Welding Prize Competition, as announced by its sponsors, is to stimulate engineers and designers in every line of industry to think of the manufacture of their own products by the use of arc welding and to increase their knowledge of the feasibility of its application.

The competition is open to any person in the world except the employees of the sponsors. The closing date for the competition is October 31, 1931. For complete details of the rules governing the competition address: The Lincoln Electric Company, P. O. Box 683, Cleveland, Ohio.

Infantry Shooting Maintains High Standard

DURING the year 1928-29, of the 24,742 American doughboys that fired the caliber .30 rifle qualification course, 23,414 qualified as marksmen or better. These figures indicate that the present-day American retains the heritage of his forefathers of accurate shooting.

Rifle shooting in the Infantry regiments during 1929 showed a marked improvement over the records of the preceding years. In 1929, 94.63 per cent of the doughboys firing the course obtained qualifying scores. In 1928, 93 per cent qualified. In 1927, 91 per cent qualified. The increase in efficiency in firing was attributed to more minute attention to details and to the continuous increase in interest and pride of the American infantryman in his marksmanship ability.

Of the 23,414 qualified, 3,772 were rated as expert riflemen, entitling them to five dollars extra pay per month. In 1928, 3,680 made expert riflemen. In 1929, 6,667 succeeded in obtaining the next highest qualification, that of sharpshooter, which entitles them to draw three dollars extra pay per month. 6,501 qualified as sharpshooters in the year 1928. 12,975 obtained qualifications of marksmen in the year 1929. In 1928, 12,566 qualified as marksmen.

The 16th Infantry, stationed at Fort Jay (New York City), New York, and Fort Wadsworth (Staten Island), New York, the 65th Infantry (San Juan), Porto Rico, the latter composed entirely of native Porto Ricans, and the 18th Infantry stationed at Fort Hamilton (Brooklyn), New York, and Fort Schuyler (Westchester), New York, qualified 100 per cent. The average score per man in the 16th Infantry was 297.2 out of a possible 350. In the 65th Infantry, the average score was 297.16, and the 18th Infantry averaged 286.27 per man. The 45th Infantry, stationed in Manila, Philippine Islands, composed entirely of native Filipinos, established a very creditable record, qualifying 99.37 per cent of the men that fired. Only five of the 793 men firing failed to attain the necessary qualifying score.

Other Infantry regiments that distinguished themselves on the range last year were the 5th Infantry, Portland, Maine, qualifying all but five of the 549 men that fired. The 15th Infantry, Tientsin, China, failed to qualify only six men.

The rifle qualification course fired by the Infantry of the Regular Army consists of 70 shots, the maximum possible score being 350 points. The 70 shots are divided into slow and rapid fire. 10 shots, slow fire, with no time limit restriction, are fired from each of the following ranges: 200 yards from standing position; 300 yards sitting and kneeling position; 500 yards prone position; 600 yards prone position from a sandbag rest. Rapid fire, with time limits varying from one minute to one minute and twenty seconds, depending upon the range, is fired from 200, 300, and 500 yards, ten shots being fired from each range.

Out of a possible 350 points a minimum of 240 are required for qualification as marksman, between 290 and 305 for sharpshooter, and 306 and above entitles the soldier to the highest qualification—that of expert rifleman.

Carrier Pigeons Still Depended On In Battle

CARRIER pigeons, whose value in warfare was proved when radio was in its infancy, are still holding a place as a supplement to wire and wireless communication in the Army, although the homing birds have virtually been abandoned by the Navy.

Despite economy reductions some five years ago, the Army still has approximately 700 pigeons, about 450 of which are at Camp Monmouth in New Jersey where the birds are bred and trained and supplied to other stations. Schofield Barracks in Hawaii is another large training point.

The Navy in September, 1929, had 800 pigeons, when an order was issued that "all pigeon activities will be abolished in the Navy by October 1 at all stations with the exception of the Naval Air Station, Lakehurst, N. J., and at the Naval Station, Guam."

In explanation of this order, the Navy Department announced that "during the war and at other times in the past, pigeons as a means of communication have been of value and interest to naval aeronautics, but of late their value has been materially decreased by developments and improvements in aircraft radio—all naval planes making distant flights being required to report at stated times. The Navy has decided that due to the shortage of personnel and to shortage of funds it is advisable to discontinue these activities. Twenty enlisted men will be released for other duty by this action."

Naval officials explain that the birds which have been retained at Lakehurst and Guam are for use in lighter-than-air craft, particularly free balloons not equipped with radio.

It is not with the Army Air Corps but, on the contrary, with the ground troops who do the close-up fighting and trench warfare that the Signal Corps employs its trained homing pigeons. The customary procedure when using the carriers is to send about four forward with a battalion of infantry, or cavalry doing reconnaisance work.

Signal Corps officers stress, however, that the birds are carried, not as competitors of the wireless or telephone but as supplements to the more convenient forms of communication. When ground troops are moving forward into new territory, wires are laid for telephone service. One-man portable radio sets are carried, while homing pigeons are a third factor in the communications equipment. All, of course, are subject to destruction by shell-fire and when one service is eliminated the others must suffice. It was a homing pigeon that did the work for the Lost Battalion during the World War.

The modern radio, however, not available during the World War, promises largely to replace homing pigeons in future and Signal Corps officers admit that opinion is divided on the subject of continuing their breeding and training.

While the number actually maintained is not large, Signal Corps officials point out that the birds are quickly bred and trained, and that private fanciers can be called upon for large numbers on short notice.

Telephone wires still perform the major burden of military intelligence transmission on land in time of war. Where wires cannot be laid, the Signal Corps falls back on radio. If the enemy succeeds in destroying the radio equipment in a given sector, the carrier pigeon must be relied upon to escape the fire of which it is always a target.

Antiaircraft Moving Pictures

A TRAINING film entitled "The Tactical Employment of the Antiaircraft Regiment," produced by the Signal Corps, has been approved by The Adjutant General for release to the Army. This picture was filmed at Aberdeen Proving Ground, Maryland, last spring with troops of the 62nd Coast Artillery (A. A.) participating. It was recently reviewed by the Chief of Coast Artillery, General Gulick, who pronounced it an excellent subject, both for instructing military personnel, and informing the layman of the latest developments in antiaircraft equipment.

The film, which is four reels in length, opens with scenes of World War bombing by enemy planes and depicts the latest type material and methods now in vogue to combat enemy planes by means of gun-fire. The tactical phase of the picture illustrates the ramifications of an antiaircraft artillery regiment going into position, its methods of observation, communication and fire.

This picture is considered to be especially adapted for instructing the National Guard and Reserve forces. It will soon be widely distributed in both the standard size film and in the 16-mm. or "home movie" size.

The Autogyro As An Instrument of Defense

HOPEFUL that the newly-developed auto-gyro plane may replace kite balloons and observation planes, the Department of the Navy is considering the purchase of one or two of these new craft for experimental use.

Present development of the new craft, which has an extremely low landing speed and the ability to take off and land in much shorter space than is required for present-day heavier-than-air machines, has not reached the point where the autogyro may be considered suitable for all uses, David S. Ingalls, Assistant Secretary of the Navy, recently announced, but the possibility of employing the new ship in certain restricted classes of naval aviation is worthy of study.

"The autogyro might replace kite balloons or planes which do not require high speed and ability to engage in combat," the Assistant Secretary explained. "In these particular cases, we believe this new invention is likely to be-

come extremely important, and for this reason we hope to conduct tests with one or two experimental ships in the future."

Characterizing development of this new plane as "the first real invention in aeronautics since the Wright brothers first succeeded in flying," Mr. Ingalls stated that he believed the autogyro would be "the answer to private flying difficulties."

Disadvantages held against the autogyro at present, he pointed out, are that its top speed is somewhat less than that attained by normal aircraft of about the same features and that it still has some structural weaknesses which must be improved.

"I have no doubt that these difficulties can be overcome," Mr. Ingalls added. "We have always found the means of surmounting obstacles of this sort and can expect that perfection of this new type of aircraft will remedy any difficulties apparent at present."

Private aviators may expect the autogyro to solve problems which now restrict the use of airplanes. The autogyro is easy to pilot and methods of operating it can be learned in much less time and with much less effort than operation of biplanes and monoplanes.

"Where top speed can be sacrificed, its serviceability in military and naval aviation seems assured," Mr. Ingalls said. "It will require additional development and experimentation to bring the new craft to a point where its use is matter-of-fact, but undoubtedly there will be uses for this plane in the military and naval fields.

"One difficulty is that it cannot carry guns to protect itself from attack from above," he continued, "and this limitation of range in gunnery will be a problem which must be given study. Probably some day we will be able to get out of it as great speed as we now get out of the common-type planes, and even today its top speed compares well with that attained by planes of similar size and design. The problem in streamlining should not be difficult to overcome."

The ability to land and take off in a short distance is one of the features which has caused the Navy to watch with enthusiasm the performance of the craft, Mr. Ingalls said. This may be a great advantage in naval aviation where landing decks are limited in size.

Old Destroyers to Be Bombed

BOMBING practice with the hulks of two decommissioned destroyers, the SLOAT and the MARCUS will be the first research to determine the comparative effectiveness of 30- and 116-pound bombs since the Navy employed the battleship "Washington" as a target for aircraft attacks in 1921.

The SLOAT and the MARCUS are to be attacked off the Pacific Coast this winter, while a third decommissioned destroyer, the STODDERT is to be equipped with remote-control apparatus and converted to a "perennial target." Experiments with the STODDERT probably will not be inaugurated until early 1931.

The success of the tests with the STODDERT, which will be subjected to machine gun attacks by airplane and will be a target for dummy shells and bombs, will determine a course of action for the future, since tentative plans already have been drawn up to convert five other decommissioned destroyers for similar bombing and firing practice.

Routine bombing and gunnery practice is performed by the aircraft squadrons each year, but only towed and stationary wooden targets and towed sleeve targets are used. An armored target has not been employed during the past ten years, and the routine practice determines only the percentage of hits.

Use of the two destroyer hulks as stationary targets will result in a financial saving for the Department of the Navy. The ordinary wooden targets used cost $18,000 each, while the value of the two cruisers to be tested is estimated at $5,000 each, the amount which the Navy might expect to receive if these vessels were sold for scrapping.

The radio-controlled STODDERT will be a target for dummy bombs and "dud" shells from the secondary 5-inch battleship batteries, and will be towed back to port for patching after each test. Such an arrangement is expected to extend the life of the target vessel indefinitely and if the plans work out satisfactorily five other destroyers not yet selected will be used for this purpose.

Radio-controlled targets provide more realistic conditions for tests, although the vessels are not protected by anti-aircraft guns or defensive airplanes. The greater speed at which such vessels can be maneuvered, however, is important in testing the accuracy of hits since the towed targets do not exceed a speed of eight knots.

Reservists Study Procurement Planning

FIFTEEN reserve officers completed on October 24, 1930, a two weeks' course of instruction and duty in connection with the procurement activities of the Office of the Assistant Secretary of War in Washington, D. C.

The course included a series of lectures covering the many phases of the subject, together with collateral reading and study. Maj. Donald Armstrong, Ord. Dept., U. S. A., was in charge of the instruction.

The following reserve officers completed the course: Col. Charles W. Miller, Ord. Res., Detroit, Mich., specialist in production of crude petroleum and natural gas; Lieut. Col. Leon W. Chase, Ord. Res., Lincoln, Neb., manufacturer of farm machinery; Maj. Herbert Ephgrave, Spec. Res., of Birmingham, Ala., assistant general manager, Goslin Birmingham Manufacturing Co.; Maj. Jonathan C. Hinton, Eng. Res., Chicago, Ill., western representative of William Sellers & Co., Inc., of Philadelphia, Penn.; Maj. Chauncey Elroy Orton, Spec. Res., Dayton, Ohio, Chief of Finance Budget Office, Wright Field, Ohio; Maj. George G. Phillips, Spec. Res., Dayton, Ohio, inspector of aircraft; Maj. Robert Armstrong Radford, Eng. Res., of Washington, D. C., consulting engineer; Maj. Herbert Angell Whitney, Spec. Res., Washington, D. C., valuation engineer; Capt. Errett Bishop, Sig. Res., Philadelphia, Pa., field engineer of the Electric Storage Battery Co.; Capt. J. A. Cartwright, Eng. Res., Nashville, Tenn., senior cost accountant, U. S. Engineers' Office, Nashville, Tennessee; Capt. Frank Anthony Cerruti, Air Res., Detroit, Mich., Register of Deeds Office, Wayne County, Mich.; Capt. L. C. Everett, Sig. Res., Montclair, N. J., construction engineer, RCA Communications, Inc.; Capt. Charles E. Herrstrom, Ord. Res. Boston, Mass., patent attorney; Capt. Walter M. Moore, Air Res., Osborn, Ohio, technical assistant, Finance Budget Office, Wright Field, Ohio; Capt. Charles T. Wiley, Eng. Res., Richmond, Ind., electrical engineer.

AOA

Note and Comment

Hail and Farewell

HAIL and farewell was the keynote of a gathering of officers of the Ordnance Department at the Army, Navy and Marine Corps Country Club, near Washington, D. C., September 5, 1930. Farewell was said to Gen. Odus C. Horney, who on September 30 was retired from the Army after more than 43 years of active service. Greetings were extended Brig. Gens. William H. Tschappat and Edwin D. Bricker, recently promoted to be Assistants to the Chief of Ordnance.

General Horney is too well known and his service to the nation too exceptional to attempt to appraise them in this place. He is held in highest esteem by his military and civilian associates. His work in the field of ammunition and explosives will always be a brilliant phase of the record of ordnance progress. The promotions of Generals Tschappat and Bricker we have referred to in recent issues of ARMY ORDNANCE.

The impelling thing we wish to comment on here is the great scheme of things which such occasions accentuate. A life of active military service completed, the accession of others to command, the ever-changing complexion of men, things and places and the continuity of it all.

Not so long ago we visited the Military Academy at West Point. As we sailed up the Hudson the Battle Fleet was at anchor in the river. In deference to a distinguished gentleman on board the day liner, blue jackets were drawn up at attention with bands playing on every ship. At the Academy the always inspiring parade was reviewed. The two displays would have thrilled a stoic. "Duty, Honor, Country." Generation after generation they come and go. Traditions accumulate, principles are unchanged. Individually each man devoting a life to the high ideals of professional service.

The "hail and farewell" gathering is another case in point. One career of active service terminates, others continue on. Still others are only beginning. Ours is not the philosopher's role but one does not have to be a philosopher to thank his stars for men of zeal whose devotion to duty is one of the fine things of life, whose ability in the aggregate makes our Army and Navy inspiring institutions worthy of a great people.

Whittling to Fame

WITH the United States team again the winner of the Argentine Trophy at the recent National Rifle Matches at Camp Perry, "the whittling stick"—the team's good luck guarantee—makes its exit from the ranks of the ordinary rabbit's foot, horse chestnut and two-cent pocket piece to enter the exclusive confines of the charmed circle. The "whittling stick" started upon its famous career in 1922 from a tent peg—and a broken peg at that—at Quantico when the United States team was practicing for the International Match.

Maj. L. W. T. Waller, U. S. M. C., captain of the team,

CLE-FORGE HIGH SPEED DRILLS
TRADE MARK REG. U.S. PAT. OFF.

TRADE MARK REG. U.S. PAT. OFF.

Since 1924, Cle-Forge High Speed Drills have held the world's records for drilling through cast iron, machinery steel and chrome nickel. Why not send for "Speed and Feed Tests" and Performance Data?

The CLEVELAND TWIST DRILL COMPANY CLEVELAND NEW YORK-CHICAGO-LONDON SAN FRANCISCO
TRADE MARK REG. U. S. PAT. OFF. AND FOREIGN COUNTRIES

GAUGING and WEIGHING

.30 CALIBER CARTRIDGE CASES

This semi-automatic machine will gauge and weigh loaded cartridges, or gauge unloaded, primed cases. Hourly production at 70 per cent efficiency, 2100.

THE WATERBURY FARREL FOUNDRY & MACHINE COMPANY

Waterbury Connecticut U. S. A.

EQUIPPED

---- physically
--- technically
-- metallurgically
to keep pace with the trend towards aluminum and its alloys

ALCOA
ALUMINUM
COMPANY
OF AMERICA
Pittsburgh, Pennsylvania

ALCOA ALUMINUM
IN EVERY COMMERCIAL FORM

NORTHWEST

THE world's largest exclusive builders of gasoline, oil burning and electric powered shovels, cranes and draglines.

NORTHWEST ENGINEERING COMPANY
28 East Jackson Boulevard
Chicago, Illinois

AO7,8Gray

while discussing the outfit and its shooting, picked up a tent peg and started whittling. The stick was preserved and at the team's departure it was carried along with the assurance that, if Major Waller would whittle on it while the team was firing at Milan, Italy, victory would be assured. He whittled, the team won and incidentally set a world's record. The stick traveled with the team to Rheims, France, in 1924. Major Waller lined up his men, crouched on his heels on the firing line and started whittling. The American team won again. The performance was repeated at the Olympic match in the same year—victory again. Then the team—and the stick, of course—went to Lima, Peru, for the Pan-American Match and again victory.

When the American team went to France in 1925 to shoot in the International, the whittling stick was left behind. Defeat! In 1926 the International was fired in Switzerland; no whittling stick; defeat again.

Capt. Harry L. Smith, U. S. M. C., took the team to Rome, Italy, for the 1927 International. Shortly after he landed he became very ill and his team shipped him back to the United States. The whittling stick was in his baggage and accompanied him. Captain Smith awakened at sea, and, sick as he was, he remembered the whittling stick. Fear struck at his heart; had they thought to get the whittling stick out of his baggage? A frenzied search revealed it, much to his disappointment. A wireless was sent to the team, saying, "I'm whittling hard" and he started whittling at the time the team approached the firing line. The team lost. It was out of the "zone of influence" of the whittling stick. The stick wouldn't be fooled.

The magic stick was taken to The Hague, Holland, in 1928 by Col. D. C. McDougal, but for some reason undetermined, it was not whittled upon. The team lost. Again it was not consulted or whittled in 1929 when the American team went to Stockholm, Sweden, to shoot in the International. Defeat, naturally.

When Maj. J. K. Boles set out with the American team for Antwerp, Belgium, to compete this year, the whittling stick was taken along. Guns might have been left behind but not the whittling stick. It was to be put to a test after this string of non-whittling and losing matches. Major Boles was certainly going to whittle on the whittling stick on the firing line while his team was firing. He did. The team won, and brought back the Argentine Trophy. The trophy is kept in an ordinary exhibition room but the whittling stick is kept in velvet in a safe by Brig. Gen. Milton Reckord, executive vice-president of the National Rifle Association.

We wonder what will happen when the charmed tent peg is whittled away. We suggest the tiniest possible slivers in future; household as well as rifle-range gods deserve velvet cases. Best team or not, a successor to the old peg may never turn the trick at all. To whittle a new stick may be to fiddle while Rome burns.

Methods of Testing Weapons Have Changed

ACCORDING to *Nickel Cast Iron*, von Eulenspiegel in his "Ancient Method of Hardening Damascus Blades" describes the rather unusual manner of testing those famous weapons as follows:

"Let the high dignitary furnish an Ethiop of fair frame, and let him be bound down, shoulders upward, on the block of the god Bal-Hal. . . . Then, let the master workman,

having cold-hammered the blade to a smooth and thin edge, thrust it into the fire of the cedarwood coals, in and out the while reciting the prayer to the god Bal-Hal, until the steel be of the color of the red of the rising sun when he comes up over the desert toward the East, and then, with a quick motion, pass the same from the heel thereof to the point, six times, through the most fleshy portion of the slave's back when it shall have become the color of the purple of the king. Then, if with one swing and one stroke of the master workman, it severs the head of the slave from his body, and displays no nick nor crack along the edge, and the blade may be bent around the body of a man and break not it shall be accepted as a perfect weapon. . . ."

Believe it or not, we listened not so long ago to a world-famed steel magnate who during his travels purchased what was alleged to be one of the famous Damascene blades and had the metallurgists of his plant determine its constituent elements. The result was, as the narrator expressed it: "We couldn't have made such bad steel in our plant if we had tried." Maybe that particular blade was not the genuine article, after all. Or if it was, may be "an Ethiop of fair frame" had not been bound down on the block before the god Bal-Hal. Or if he had, maybe in severing the head from the fair frame the blade failed. Anyway, it was an unique method of testing and we don't regret that it was discarded long ago.

Nansemond

NOT far from the historic spot where the Nansemond, James and Elizabeth rivers, on their way to the Chesapeake, converge into Hampton Roads, Virginia, birthplace of the era of the armored warship, Nansemond Ordnance Depot occupies a strategic place on the geographic and military supply maps of our country. Not long since the depot discarded its old *nom de guerre* "Pig Point" for its present pleasing and loreful name.

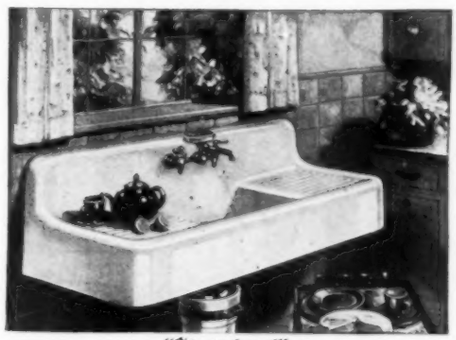
Nansemond has become a worthy member of that important chain of supply stations which store and transmit ordnance to the various services of the Army. "On their toes" at all times to do the job in hand with thoroughness and speed, its personnel have the faculty of tempering routine with the necessary ingredient of relaxation. Just recently the military contingent observed with fitting celebration the eleventh anniversary of the organization of the 56th Ordnance Company which is stationed at Nansemond. Athletic events, swimming contests in the new pool, a banquet and ball marked the event. "Organization Day" will be similarly observed in future. The chain stores of our military supply system can well afford to honor valiant service at all times. Handling ordnance stores is the small-mouthed bottle neck of munitions supply, the cap of which should be pryed loose occasionally to add zest to the day's work and spirit to the traditions of any establishment. Nansemond, while carrying on an important function is adding its own bit of lore to the hallowed precincts in the midst of which it stands.

Members of the Army Ordnance Association and subscribers for ARMY ORDNANCE are requested to notify promptly the executive office of the Association of change of address. Notices sent to the Army Ordnance Association, The Mills Building, Pennsylvania Avenue at 17th Street, N. W., Washington, D. C., will be attended to without delay.

Metropolitan
N.E.C. & Plug Fuses
Are Not "Just Made"
They Are DESIGNED for
100% Dependable Protection
(Underwriters Approved)

MANUFACTURERS SINCE 1892
of
Switchboards . Panelboards
Knife Sws
Enclosed Fuses
Plug Fuses
Safety Apparatus
Flush Switches . Receptacles
Facelites
Electrical Appliances
Built to Order.

TRADE METROPOLITAN MARK
ELECTRIC MFG CO.
East Ave. and 14th St., Long Island City, N. Y.



The "Three 8's" Sink

"Standard"

Sparkling beauty--
utmost convenience

THESE characterize the "Standard" Three 8's sink, now made in white or nine beautiful colors. A new massive beauty, a deeper sink compartment, a lower back to fit under a deep window, Acid-Resisting Enamel not harmed by fruit or vegetable acids and easy to clean, and Chromard fittings, non tarnishing, non-corroding—all these are features of the 3-8's sink. Consult your plumber.

"Standard" PLUMBING FIXTURES

Standard Sanitary Mfg. Co.
PITTSBURGH
DIVISION OF
AMERICAN RADIATOR AND STANDARD SANITARY CORP

UNITED ENGINEERS
& CONSTRUCTORS INC.

combining

Day & Zimmermann
Engineering & Construction Co.
Dwight P. Robinson & Co., Inc
The U. G. I. Contracting Co.
Public Service Production Co.

Design and Construct

INDUSTRIAL PLANTS
STEEL MILLS
POWER DEVELOPMENTS
RAILROAD WORK
GAS PLANTS

Build

APARTMENTS
HOTELS
OFFICE AND INSTITUTIONAL
BUILDINGS

UNITED ENGINEERS & CONSTRUCTORS
INCORPORATED
DWIGHT P. ROBINSON, PRESIDENT

PHILADELPHIA LOS ANGELES NEW YORK BUENOS AIRES NEWARK RIO DE JANEIRO CHICAGO MONTREAL

MAXIMUM RETURN TO CLIENTS PER DOLLAR INVESTED

CITY
COUNTY
STATE
FEDERAL
GOVERNMENTS

USE LORAINS

—for instance below is shown a Lorain-75 operated by the U. S. Engineering Department in the first and second Mississippi River Conservancy Districts. Built with ¾ to 1½ cubic yard dipper and bucket capacities and 10 to 15 ton lifting capacities—Shovels, Cranes, Draglines, Backdiggers, Skimmers and Locomotive Cranes.

THE THEW SHOVEL COMPANY, LORAIN, OHIO

THEW

Association Affairs

New Members

THE following were admitted to membership in the Association during the period September 1 to October 31, 1930: Bruce E. Anderson, Washington, D. C.; Anson Averell, Berkeley, Calif.; J. C. Baird, Rockaway, N. J.; R. H. Bassett, Fort Sam Houston, Texas; H. H. Bates, Ridley Park, Pa.; Ray T. Bayless, Cleveland, Ohio; G. E. Beggs, Princeton, N. J.; J. C. Bliss, Princeton, N. J.; Robert E. Bultman, Cleveland, Ohio; Wm. P. Calder, Bristol, Conn.; Donald R. Cameron, Wharton, N. J.; Leroy R. Carl, Dover, N. J.; R. A. Carlson, Rockford, Ill.; Melbert B. Cary, Jr., New York, N. Y.; D. F. Clabaugh, Birmingham, Ala.; Charles I. Clark, New York, N. Y.; William H. Coit, Wanakah, N. Y.; F. H. Constant, Princeton, N. J.; F. S. Cooper, Princeton, N. J.; George L. Cooper, Chicago, Ill.; C. B. Corridon, Rockaway, N. J.; F. E. Daniels, Harrisburg, Pa.; Corwine S. Davis, Dover, N. J.; Richard C. Dehmel, New York, N. Y.; Richard J. Doggett, Dover, N. J.; Fred Eagles, Dover, N. J.; J. E. Evans, Atlanta, Ga.; Stanley Farrow, Dover, N. J.; Luther A. Fisher, York, Pa.; Hugh L. Gaddis, Cleveland Heights, Ohio; R. Theodore Garfein, Easton, Pa.; Thomas B. Gay, Alhambra, Calif.; T. C. Gerber, Washington, D. C.; Edward F. Gilroy, Jamaica, L. I., N. Y.; G. G. Goodling, York, Pa.; George D. Green, Jacksonville, Fla.; Charles R. Hamme, York, Pa.; C. H. Harper, Dover, N. J.; H. B. Harris, Chicago, Ill.; Herman A. Harris, Washington, D. C.; F. A. Heacock, Princeton, N. J.; J. Donald Hopper, Dover, N. J.; Chas. G. L. Huether, Baltimore, Md.; Andrew W. Keegan, Clifton Heights, Pa.; W. C. Keith, Princeton, N. J.; Charles A. Kelley, Cleveland, Ohio; Harry F. Knapp, Washington, D. C.; Alfred S. Kos, Avon Lake Village, Ohio; Gerald T. Kurtz, Oakland, Calif.; Leon W. Leeper, York, Pa.; Carson Linebaugh, York, Pa.; Ernest R. Linebaugh, York, Pa.; Joseph H. Lucas, Dover, N. J.; W. P. Lyman, Gulfport, Miss.; Harold W. Lyons, New York, N. Y.; Frank E. MacCordy, Fulton, N. Y.; Walter L. Main, Wilmington, Del.; K. G. Martin, New York, N. Y.; Stephen M. Martin, Teaneck, N. J.; Judson Mather, Albany, N. Y.; W. B. McClelland, Cambridge, Mass.; V. L. Mickman, Dover, N. J.; Leonard J. Miller, Philadelphia, Pa.; G. H. Mitchell, Jr., Dover, N. J.; L. F. Moody, Princeton, N. J.; C. W. Morehead, Princeton, N. J.; G. L. Murray, Dover, N. J.; Alfred W. Nagle, Ensley, Ala.; George Nagengast, Fords, N. J.; G. G. Naugle, York, Pa.; J. S. Nicholas, Cleveland, Ohio; W. E. Niles, Watertown, Mass.; Julius C. Nix, Washington, D. C.; Robert H. Noble, Dover, N. J.; Donald S. Parsons, Washington, D. C.; C. E. Patterson, Chicago, Ill.; Edward C. Peterson, New Brunswick, N. J.; J. L. Phillips, Birmingham, Ala.; Warren A. Ransom, Rye, N. Y.; Karl D. Reyer, Norman, Okla.; Warner J. Roberts, New York, N. Y.; Albert Safine, Berkeley, Calif.; DeWitt D. Sager, Wharton, N. J.; C. E. Seavey, Dover, N. J.; Alva B. See, New York, N. Y.; R. A. Spicer, Dover, N. J.; Robert W. Stark, Hazleton, Pa.; Richard J. Stock-

ham, Birmingham, Ala.; Charles M. Swezey, New York, N. Y.; Alden Twaetman, Greenwich, Conn.; Pierre Varrato, Dover, N. J.; W. DeWitt Vosbury, Camden, N. J.; J. C. Walker, Atlanta, Ga.; Jason M. Walling, Toledo, Ohio; G. E. Webster, Dover, N. J.; C. E. Wheeler, Dover, N. J.; J. C. Whitewell, Princeton, N. J.; Harry Woodhead, Cleveland, Ohio; D. Philip Young, York, Pa.; John D. Zink, Longmeadow, Mass.

Necrology

SINCE publication of the last issue of ARMY ORDNANCE, notice has been received of the death of the following members: Milford H. Clark, Jr., Buffalo, N. Y.; Edward B. Danenhower, Pittsburgh, Pa.; James C. Davis, Chicago, Ill.; Nils Falk, New York, N. Y.; George M. Newcomer, Woodbridge, N. J.; Andrew L. Riker, Fairfield, Conn.; Fred W. Stark, Hazleton, Pa., and Charles A. Tripp, Wilmington, Del. On behalf of the Association, ARMY ORDNANCE extends sympathy to the relatives and friends of these gentlemen whose patriotic interest in ordnance was an evidence of their devotion to the national defense.

Association Membership

THE Association has its government vested in a Board of Directors, six of whom are elected by general ballot of the entire membership, for terms of four years, and one director representing each local post, the latter being elected by the respective posts. The officers, with one director elected by the Board of Directors, constitute the Board of Trustees which has the active management of the affairs of the Association. The President and Vice-Presidents are elected every two years by general ballot and the Counsel, Treasurer and Executive Secretary are appointed by the Board of Directors. The Association was incorporated in 1928 under the laws of the District of Columbia.

Over 90 per cent of the membership of the Association consists of executives and engineers of American industry who are cognizant of the importance of industrial preparedness. These gentlemen who, through affiliation with the Association are kept informed of current development of munitions, constitute a large portion of the civilian nucleus upon whom our Government will depend for the manufacture of ordnance in time of emergency.

The following extracts from the Constitution and By-Laws of the Association define the several classes of membership.

"SEC. 1. Full membership in the Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"SEC. 2. Life membership in the Association shall be open to all men who are American citizens and who are interested in promoting the cause of industrial preparedness, particularly in connection with the design, procurement, production, manufacture, inspection, test or supply of ordnance material.

"SEC. 3. Student membership in the Association shall be open to all men who are American citizens and who are students in technical schools or colleges. Student members shall not vote or hold office in the Association.

ACME after many years of Service have proven the *Quality* and *Durability* of

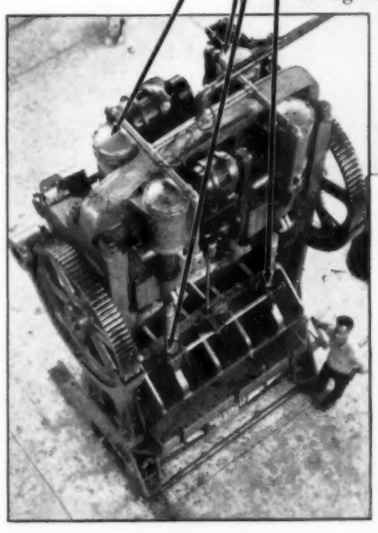
ACME BOLT THREADING
NUT TAPPING
BOLT POINTING
HOT PRESSED NUT
BOLT & RIVET HEADING
ALL STEEL UPSETTING
and FORGING MACHINES

The Acme Machinery Company
4533 St. Clair Ave.
CLEVELAND
OHIO

ANNOUNCING
MARQUETTE
4 POINT SUSPENSION PRESS PATENTED

An entirely new type of press—

***Power is supplied to the slide directly and simultaneously to the four corners instead of through the center line,* eliminating side thrust, bending strains and shearing of dies. Brings slide down with faces precisely parallel to bed.**



Insures more accurate work, less wear and tear on dies and presses. Can have air cushion blank holder built in, making press complete self-contained unit, easy to move if desired.

Write for information.

MARQUETTE TOOL & MFG. CO.
6489 W. 65th Street
CHICAGO, ILLINOIS

THE AEROCRETE CORPORATION OF AMERICA

51 East 42nd Street
New York City

Manufacturers of Insulating AEROCRETE ROOFSLABS and AEROCRETE ROOFS POURED-IN-PLACE.

Table showing Insulation Value of AEROCRETE of different Density.

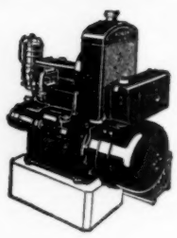
Density	Heat Conductivity
D	C
30	0.69
40	1.05
50	1.44
60	1.80
70	2.18

D=Lbs. per cubic foot
C=B.T.U:s per sq. ft. per inch thickness per degree Fahr.

NOTE:—The heat conductivity coefficient for concrete is 8.00.
50 lb. Aerocrete is 5½ times as good insulator as concrete.

SPECIFY AEROCRETE ROOFS AND SAVE HEAT LOSSES

Seaworthy Electricity



Genuinely dependable — such is the Kohler Electric Plant installed for emergencies on government cruisers, destroyers and mine-layers. Let the vessel roll and pitch at heavy seas—the faithful Kohler Automatic efficiently generates 110 volt current for radio receiving and sending. Also, for emergency lighting. We will gladly send complete information about Kohler Electric Plants. Sizes—800-watt to 10 K. W.—there are no storage batteries. Kohler Co., Kohler, Wis.

KOHLER OF KOHLER

AOA

Book Reviews

The Real War, 1914-1918. By Capt. B. H. Liddell Hart, with twenty-five maps. Boston: Little, Brown and Company. 1930. $4.00.

ENGLAND'S literary exports to this country have included, of late years, many welcome additions to the military library from the pen of Captain Liddell Hart. He has accustomed us to his clarity of thought and expression, his sound judgment on men and matériel, and his incisive criticism of strategy and tactics. There was reason to expect a good book on the war under the present title. Expectations have been more than realized. It is not too much to say that his book justifies the title, and can easily replace a whole library of miscellaneous books on the World War.

"Seeking the bubble Reputation,
Even in the cannon's mouth"

is an unprofitable venture when Liddell Hart finishes his deflating process. He is no respecter of persons or rank. If he deems a reputation undeservedly achieved, nothing in this world can keep him from saying so. It would be an exaggeration to write that "at every word a reputation dies," but this is a truth-seeking history of the war and defects in judgment, in plans, in general staff work are sharply criticized.

The military and naval operations from 1914 to 1918 are almost exclusively the subject of the book. The political, social and economic phases of the war are but lightly touched upon. Capt. Liddell Hart has adopted a most satisfactory method of describing the operations on land and sea. The events of each year of the war are outlined briefly and clearly, and then in succeeding chapters he describes the details of the important operations. This history of the war is an impartial account of the four years' struggle, decidedly superior to any military narrative of the period that has yet appeared.

The Reminiscences of a Marine. By Maj. Gen. John A. Lejeune, U. S. M. C. Ret. Philadelphia: Dorrance and Company. 1930. $4.00.

AS a plebe at the Naval Academy, fourth classman Lejeune was instructed by an upper classman to give his name as "Gabriel LaJeunesse," the Acadian hero in Longfellow's epic Evangeline. The nickname stuck and to this day General Lejeune is "Gabe" to his classmates. The reference to Gabriel is not far-fetched for the ancestors of the heroic idol of the Marine Corps were among those who, upon the advance of the British on Acadia during the French-Indian War of 1756, left their native heath and later sailed down the Mississippi to settle in the Parish of Pointe Coupée, Louisianna, not far from the Bayou Teche country where the Acadian exiles themselves found their way.

There is too much of inspiration in this volume to tax the limitations of a reviewer in these pages. There is the touching tribute at the beginning that "whatever success I may have achieved as a man has been due to the beneficent

influence of a deeply religious and most loving mother, a father of great nobility of character, a truly devoted sister and a wife who has been always unselfish and always loving; and that whatever military success I have achieved has been due to the fidelity, the loyalty, the devotion to duty and the courage of the officers and men with whom I have been associated since that day that I entered the service more than forty-five years ago. I salute them whether they be among the living or the dead." There is the frank statement at the end: "Every word of this book I have written down in long hand, and if perchance my readers find some pleasure in its pages I shall feel fully repaid. There is no rancor in my soul toward any man, and it is my earnest hope that no word I have written will cause anyone pain."

With such deft touches "Gabe" Lejeune sketches a human interest biography which deserves place among the best of American military and naval literature. We follow young Lejeune (redundant phrase though it is) through boyhood and college days, at the Naval Academy as a naval cadet and the shipwreck of the *Vandalia*, through the Spanish-American War and the landing at San Juan, duty in Cuba and at the Army War College. Then the occupation of Vera Cruz and later duty as assistant to the Commandant of the Corps and finally the command of the immortal Second Division, A. E. F., during the World War. Visions of Nancy, Golombey-les-Belles, St. Mihiel, Blanc Mont Ridge, Meuse Argonne. But stay here a moment to note an order of November 2, 1918. "Order: The Second Division yesterday made one of the most brilliant attacks of the war. It drove forward through the enemy's fortified lines to a depth of six miles. The results of this drive are already becoming evident. The First Corps, on our left, has advanced today without opposition to Buzancy and Briquenay, and the enemy is withdrawing all along the line. When the history of America's part in winning the war is written, the renown of the Second Division will stand out preeminent. Let us press on and destroy the enemy!—John A. Lejeune."

After the Armistice and seven months on the Rhine came the return home and the Lejeune command of the Marine Base at Quantico. June 20, 1920, he was appointed Major General Commandant of the Marine Corps. This high honor he held for eight years retiring from active service March 5, 1930, to assume the superintendency of Virginia Military Institute where "the heroic spirit of the Newmarket Cadets, of 'Stonewall' Jackson and of the other 'Immortals' still prevails."

General Lejeune has written for us of today and for posterity a memoir of the first order, a biography of real merit and an unconscious tribute to the romance of those who are the "first to fight," and as they rise from the pages of his great book are of heroic mold. His life and service, even had he not recounted them in these fascinating pages, are an honor to himself and to his fellow-citizens; his own plain-telling of his story makes them doubly so.

Colossal Blunders of the War. By William Seaver Woods. New York: The Macmillan Co. 1930. $2.50.

"IN bringing forth these colossal blunders of America, Germany, the Allies, and Russia, Mr. Woods is not presenting propaganda. He is not urging militarism or armament. He is simply pointing out how lack of intelli-

The horse power of an engine costs money, but the wingpower of momentum is free! . . . and now for the first time since the first automobile was built you can get it! . . . in **free wheeling***

*With Positive Gear Control

PRESIDENT and COMMANDER

EIGHTS

Seasoned Champions . . . the only cars in the world with free wheeling under positive gear control. Manufactured under Studebaker patents.

The Studebaker Corporation of America
SOUTH BEND : : INDIANA

Reliability—Speed—Stamina—Power—Economy — Bucyrus-Erie leads in all.

STAMINA!

1¾-yard E-2 Diesel.

From the smallest to the largest Bucyrus-Erie thoroughbreds are all built with the same highest standard of materials and workmanship.

Whatever the excavating task, Bucyrus-Eries have the staunch stamina to keep faith, regardless of climate, place or circumstances.

BUCYRUS-ERIE COMPANY
Head Office South Milwaukee, Wis.

BUCYRUS ERIE

Representatives throughout U. S. A. Offices and Distributors in all principal countries.

More Hours *of* Service

in Pure Oil Products!

WHETHER you use Tiolene 100% *Super*-Pennsylvania Motor Oil in a pleasure car, tractor, truck, or aeroplane, you'll find that it out-lasts and out-lubricates other oils. Why? Because it is skillfully refined from Cabin Creek crude—the highest quality crude found on this continent.

And while Tiolene is but one of the many Pure Oil products, it is representative of their *uniform* goodness.

Pure Oil products are sold thruout twenty-six states.

THE PURE OIL COMPANY

One of the largest independent producers, refiners, marketers.

General Offices · Chicago

PIPE

OF THE FINE COPPER ALLOYED STEEL

COP-R-LOY

THE most talked about pipe today is the product of 18,000 men pledged to the standards of Wheeling Steel, conceived in 215 years of steel making experience. These employees, scarcely more than a corporal's guard when they forged cannon ball for the Army of Independence now number several thousand more than a brigade, enlisted in the cause of better pipe service. Send for a descriptive booklet, to the

Wheeling Steel Corporation
Wheeling, W. Va.

gence was the cause of hideous loss of life" and "Now is the time to bring these facts out into the light of day, while the events of the war are fresh in our minds, to prevent their repetition in any future conflict, if there should unhappily be one," say the publishers of this book. Whatever part it plays, big or little, in keeping the lessons of the World War before those responsible for the welfare of our country will make it well worth while. The astounding facts are boldly presented and ably discussed. With many of the countries of the world now in a state of upheaval and unrest, the appearance of this book at this time seems most opportune.

The author selects the failure of Germany correctly to forecast the final alignment of the various nations for or against her as the greatest blunder of the war. Which raises the question whether or not one can now read correctly the news in print and between the lines and calculate with any degree of accuracy the conduct of nations in the near future. With economy our watch word, at the expense of the national defense, well may the author raise the question, "Are we tending towards one of our extravagant catastrophies?" An understanding by every American citizen of the situations both diplomatic and military which Mr. Woods has chosen to discuss would insure a more secure building for national defense and domestic welfare. Considerable space is devoted to Russia, good use being made of Maurice Paleologue's Memoirs, but perhaps not too much in view of the interest which that nation's struggles are now demanding.

George Washington, Commander-in-Chief. By Thomas G. Frothingham. Boston: Houghton Mifflin Company. 1930. $5.00.

HERE is a book to be hailed with gratitude and congratulation to the author, Captain Frothingham, whose title as military and naval historian is well established. His earlier works "A Guide to the Military History of the World War," "A True Account of the Battle of Jutland," "The Naval History of the World War" and, from our viewpoint, his most notable volume, "The American Reinforcement in the World War," are indicative of the scholarly thoroughness and perspective to be expected in his "Washington." And these indications are not lacking. Indeed they are present in abundance.

No one can applaud more sincerely than the student of American military effort from the beginning the observation by the author that "of late the character of Washington has been distorted out of all semblance of reality." At the approach of the two-hundredth anniversary of his birth, as Captain Frothingham asserts, "it is fitting that we study the actual facts of the case and that we should allow these facts to shape the verdict without special pleadings. In a book which deals with the course of military events the narrative of facts must be the main theme and adhering to this is the only sound method of treatment." Thus the volume is not concerned with diary entry's of private life. On the contrary, the author's objective is to set forth in its true light and with its right perspective the military record of General Washington.

Much has been written of Washington in his varied aspects. Irving and the great Chief Justice Marshall have left us biographies of the first order. Latter-day essayists have tried their pens at the intimate doings of life and live-

lihood. But all too few have endeavored to record the strategy and military leadership of our first commander-in-chief. The author presents his case without argument and convinces his reader of the greatness of the man whose ability, character and devotion speak for themselves in every written and unwritten line.

How to Write. By John M. Clapp and Homer H. Nugent. New York: The Ronald Press Company. 1930. $5.00.

REGARDLESS of the kind of writing that may have to be done, this comprehensive manual will provide a source of profitable suggestions for improving both style and context.

From personal records, through letters of all kinds, reports, long papers, stories, even verse, we may run the whole gamut of written expression and in every case there is an informative and stimulating chapter to point the way to more effective composition. The emphasis on the psychological as well as the literary aspect of the subject is a most desirable innovation in a book of this kind. The authors have done their work well and their book deserves a place in every library beside its companion "How to Talk."

Charlemagne, First of the Moderns. By Charles Edward Russell. Boston: Houghton Mifflin Co. 1930. $4.00.

IT is remarkable that the author has been able to unearth such a vast store of information concerning Charlemagne, assemble it, and present it in such an interesting and delightful manner, supporting his known facts with clever analysis and reasoning in such a way that this early reformer and ruler stands forth a distinct and living personage. Extensive references attest to the exhaustive research indulged in by Mr. Russell and enhance the value of his book. It will be a surprise to many that so much may be learned from the Charlemagne Capitularies or circular letters and, indeed, that there are extant as many as seventy-five such documents dealing with his administration of a vast kingdom. As an administrator, educator, uplifter, military leader and strategist, Charlemagne far surpassed his predecessors.

This is another of the many fascinating historical narratives presented to the reading public in our day. Surely no period has witnessed a greater interest in writing of this nature. Charlemagne holds place among the luminaries of history and likewise in the list of biographies in the modern version.

As a mirror of the people, of the customs, of the history, and of the king, Mr. Russell has presented a most valuable and interesting book.

Industrial Balance Sheets. By Myron M. Strain, B. C. S. New York: Harper and Brothers. 1929. $3.50.

THIS book provides a new method of investigating the significance of balance sheets. By means of practical examples the author suggests methods of analyzing industrial balance sheets in order to determine the "probable soundness and paying ability of the organizations whose conditions they reflect." The analytical procedure suggested is apparently sound and readily applicable.

The chapter on "The Informal Indicators" is a useful and original contribution to the subject worthy of special commendation, and the book itself will prove of great value to the inexperienced in estimating the true financial status of industrial organizations in their many ramifications.

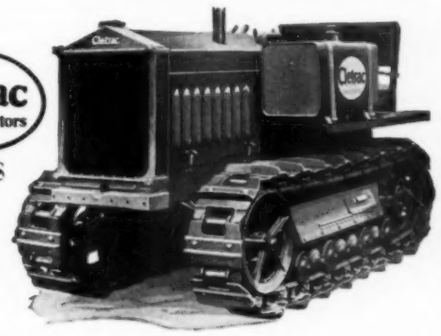
365
DAYS

After a year of average use a radio receiver should have a complete new set of RCA Radiotrons. Worn tubes should not be left in with the new ones.

RCA
RADIOTRON
"Radiotrons are the Heart of your Radio Set"

Cletrac
Crawler Tractors

MODELS
20
30
40
100



Cletrac

A Complete Line of
CRAWLER TRACTORS
for Every Type of
Industrial Work

Cletracs offer greater power—positive traction over any footing—"One-Shot" oiling—speed and short turning—Year 'Round Utility.

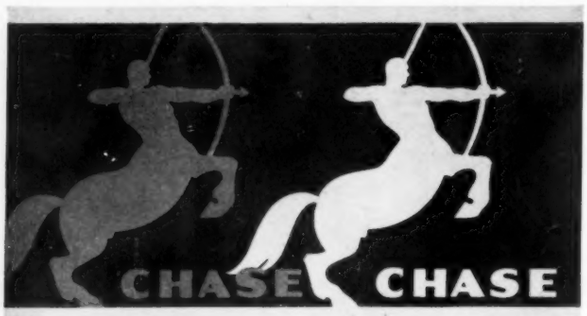
Write for Catalog and Specifications

THE CLEVELAND TRACTOR CO., Cleveland, O.

QUALITY AND SERVICE

Years of experience plus ample facilities for manufacturing mean Quality and Service. A background of 128 years in the metal industry, combined with three million square feet of floor space, modernly equipped, qualifies Scovill Manufacturing Company to meet high speed production demands for both mill and manufactured goods of BRASS, BRONZE, and NICKEL SILVER and of other metals.

SCOVILL MANUFACTURING COMPANY WATERBURY – CONNECTICUT



Brass and Copper

Immediate delivery from

19 Convenient Warehouses

Chase Brass & Copper Co.

Incorporated

Waterbury Connecticut

New York, Boston, Buffalo, Newark, Philadelphia, Baltimore, Pittsburgh, Cincinnati, Cleveland, Detroit, Chicago, Minneapolis, Milwaukee, St. Louis, New Orleans, Los Angeles, San Francisco, Oakland, Seattle.

AOA

Foreign Reviews

THE following reviews of recent foreign publications are by J. Marron Dundas, of the Editorial Staff of this Journal:

FRANCE

Revue Militaire Francaise

June, 1930

MOTORIZATION IN THE UNITED STATES ARMY. (Concluded. See May, 1930, number for Chap. 1.)

A sixteen-page article by Captain Cammas which impartially reviews the status of motorization in our army. The author gives an account of the experimental motorized force of 1928, and the article contains four tables of data on motorized equipment.

THE FIRST FRENCH ARMY AT THE BATTLE OF THE SERRE, OCTOBER 17 TO 30, 1918.

The First Army took a most notable part in this battle. It lost 6,000 men killed, of whom 60 were officers; 9,000 were wounded, including 300 officers, and 800 were reported missing. It took more than 7,000 prisoners, and captured 105 cannon, 150 minenwerfers, 1,200 machine guns and much miscellaneous matériel.

THE SPANISH ARMY IN MOROCCO.

This rather interesting description of Spain's military forces in a colony which has cost her somewhat dearly, does not conclude without some acknowledgment of the benefits of Spanish occupation, in which the army itself has taken no small part.

July, 1930

THE CAMPAIGN OF THE FIRST CORPS IN BELGIUM, AUGUST, 1914.

Among the operations of the Fifth French Army in Belgium territory in 1914, particular interest attaches to those of this corps. Frequently charged with independent missions it operated like an isolated corps, "*toutes proportions gardees, comme une armee*," in the words of the regulations of October 28, 1913, for large units. Brought up against the most diverse and most unforeseen situations, and this often during the course of the same day, it was ceaselessly obliged to adapt itself to circumstances and to carry out in the presence of the enemy maneuvers considered difficult even in peace time. It successfully withstood this test of its ability in mobile warfare, and its two weeks' campaign in Belgium is considered by the author a model the study of which cannot but be fruitful. Continued in the August number.

REFLECTIONS ON THE ENGLISH FIELD SERVICE REGULATIONS OF 1929. VOL. II, OPERATIONS.

Commenting on a disquisition in the first chapter on the origin and nature of war and kindred topics, the author appears to think that the tone of these is somewhat chastened by the Kellogg Pact, war being declared to be the last means of enforcing a policy, to be tried after diplomacy and economic action in the form of financial or commercial pres-

sure, have failed. With many others of the same school he does not believe that the pact can abolish war, nor that the military man will have to apologize for living.

MONTHYON. A LESSON IN UNFORESEEN COMBAT, SEPTEMBER 5 AND 6, 1914.

Captain Michel devotes 37 pages to this narrative. The 55th Independent Division which took part in the engagement mentioned was a reserve force. Monthyon was an episode of the Battle of the Ourq. Continued in the August number.

August, 1930

PRESENT PROBLEMS OF AERIAL BOMBARDMENT.

Colonel Aubé in speaking of aerial bombardment during the World War makes a remark which, from the evidence, appears to be just, i. e., that in spite its successes, as well as its moral effects and the important tactical results obtained, the material damage done to the enemy by such means was, on the whole, discouragingly insufficient. He cites the case of the Metz-Sablons railway station, which objective, frequently bombarded during hostilities was nevertheless found nearly intact in the course of the French advance in 1918. Such results, he asserts, have manifold causes, permanent or temporary. The most important are: bad judgment in the selection of objectives; defective technical preparation of both personnel and command; insufficient matériel, the uncertainty of night operations, and others.

Revue D'Artillerie

June, 1930

STUDY OF A CONCRETE CASE OF THE USE OF ARTILLERY IN AN ATTACK.

For previous installments of this series see the February, March, April and May, 1930, issues of this journal. Continued in the July number.

ARTILLERY IN THE OFFENSIVE IN STABILIZED WARFARE.

A translation from the German which began in the February, 1930, number. The example chosen is the battle of Riga, September 1, 1917, between the Austrian and the Russian forces. The positions of both forces are indicated, the preparations made for attack are cited. Two tables show the artillery used by groups and sectors. The orders given for the battle are also published.

APROPOS OF THE FIRE REGULATIONS OF THE ENGLISH ARTILLERY.

An examination of these regulations with particular reference to the differences between the English and the French manuals, respectively.

July, 1930

THE TRAINING OF ARTILLERY OFFICERS AFTER THE RESTORATION.

The *Ecole Royale de l'Artillerie et du Genie*, at Metz, which educated officers during the period mentioned, was founded by Napoleon when he was First Consul. Before taking the reader over the courses in this school, which afford interesting points of comparison with those of our own time, Capt. N. Aizier, Artillery, affords a glance at the matériel, organization and tactics of the time. The Gribeauval guns introduced sometime before the Revolution, were bronze 4, 8 and 12 pounders and were still in use. The course given at the school lasted two years and was supplemented by subsequent work in the garrison schools. Particularly good were the courses in artillery, fortification

SMITHWELDING

A process perfected under the stress of war for the production of aeroplane bombs became a great industrial boon in time of peace—SMITHWelding—the A. O. Smith Corporation patented process of electric arc welding. It represents the most perfect method of uniting steel, that is commercially practicable.

A bank of SMITHWelded Tanks for storing Helium at pressure of 750 pounds per square inch

A. O. SMITH CORPORATION
Pressure Vessel Division
General Offices: MILWAUKEE, WISCONSIN
District Offices: NEW YORK, TULSA, HOUSTON, LOS ANGELES
Oil and Gas Line Pipe—Pressure Vessels
Oil Cracking Stills — Automobile Frames

Brass bell and cannon *cast by Paul Revere*

Revere
Copper . . . Brass . . . Bronze

IN 1794, Paul Revere furnished cast copper and copper-alloy products to the War Department.

In 1801, he erected America's first copper-rolling mill, adding sheet copper to the Revere line.

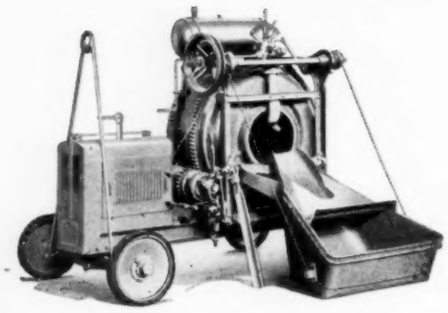
Today, Revere operates 25% of the country's Copper, Brass and Bronze rolling mill facilities and is thoroughly equipped to supply Army Ordnance requirements.

Revere Copper *and* Brass
INCORPORATED

Divisions:
Baltimore *Copper Mills* . . . . *Baltimore, Md.*
Dallas *Brass & Copper Co.* . . . . *Chicago, Ill.*
Higgins *Brass & Manufacturing Co.* *Detroit, Mich.*
Michigan *Copper & Brass Co.* . . *Detroit, Mich.*
Rome *Brass & Copper Co.* . . . *Rome, N. Y.*
Taunton-New Bedford *Copper Co., Taunton, Mass.*

ADDRESS ALL INQUIRIES TO GENERAL OFFICES, ROME, N. Y.

KOEHRING 5-S
DANDIE
Mixer



A light concrete mixer of sturdy construction for sidewalks, foundations, floors, walls and other jobs where a one bag mixer is the desired size. Quickly and easily portable.

Rubber tires or steel rimmed wheels. Power charging skip or low charging hopper and platform. Single cylinder gasoline engine and worm drive transmission.

KOEHRING COMPANY

Manufacturers of Pavers, Mixers—Gasoline Shovels, Cranes, Draglines

Milwaukee, Wisconsin

Since 1834
first in peace
first in war
RUSCO PRODUCTS

RUSCO AERO FRICTION STRUT
Controlled Suspension
Write for details
Pat. applied for.
The Russell Mfg. Co.
Middletown, Conn.

and topographic mapping. Instruction was given by lectures and no textbooks were furnished, the students being expected, and indeed required, to take copious notes.

Revue Des Forces Aeriennes

July, 1930

Aerial Reconnaissance by the Fifth Army to the Eve of the Battle of Charleroi, August 21, 1914.

According to the author, Colonel Voisin, studies which have been made of this subject have concerned reconnaissance by the First to the Fourth Army, inclusive, leaving the services rendered by the Fifth Army unrecorded. Hence the present paper. As far back as 1910 the French Ministry of War saw the great advantage of the airplane for this purpose and certain escadrilles were formed composed of volunteer officers from all arms. Continued in the August number.

Transport of Armed Detachments by Airplane.

Both French and German authorities on aviation have mooted this question. Lieut. Colonel Vauthier reviews herein a study made by Friedrich Wilhelm Borgmann, which appeared in No. 10 of *Wissen und Wehr*, 1929. If giant airplanes can be built to carry large numbers of passengers, why cannot they be used for the purpose of transporting troops? Borgmann's study is entitled "Strategic Envelopment by Air." His ideal is the enveloping movement used by Hannibal at the Battle of Cannae. Such a movement by land armies of the future will not be possible, he thinks, because their wings will rest either on the sea or on the frontiers of a neutral state, and stabilized warfare will be the rule. The airplane, in Borgmann's idea, will be and can be used for strategic envelopment.

The Development of Aerial Tours and the Military Use of the Airplane.

The author's idea is that the nation which has most highly developed commercial aviation in time of peace will have a decided advantage in time of war, in that commercial planes and matériel can be included in mobilization assets and a powerful reserve force will be the result.

August, 1930

Study of the Conditions for Using a Sanitary Hydroplane in the Navy in War Time.

The French Navy expressed its confidence in this method of transporting the wounded in 1926 by ordering two sanitary hydroplanes from the firm of Liore et Olivier. One of these is being tested at the *Centre Saint-Raphael*. While the tests have not yet been completed it is hoped to place the hydroplane in service in the near future. It is powered with a Jupiter 420 h. p. motor and can accommodate two wounded patients with a doctor, a nurse, a pilot and a mechanic. Its radius of action is a flight of four hours under full power at a speed of 150 kilometers per hour with a load of 500 kilograms. The description of this plane conveys the impression of a complete emergency hospital in miniature.

GERMANY

Heerestechnik

July, 1930

The Affinity of Interior Ballistic Curves.

In the last edition of the "Interior Ballistics" of M. G. Sugot (Paris, Gautier Villars, 1927) and in a work on the same subject written in 1914 by G. Roeggla, simplified

methods of demonstrating the affinity of these curves were given. Dr. Alex. Pappas, Professor at the Military Technical School, Athens, believes the demonstration he gives here to be even simpler and somewhat more generalized and more simply arranged than those of his predecessors.

WORK DONE ON DIRECT LIGHT RAY TELEPHONY DURING THE WORLD WAR.

The author, Dr. Leo Lowenstein, had a considerable share in the experiments and tests conducted by several groups of experts on various kinds of light rays for this purpose, including visible and invisible rays, the heat ray and the ultraviolet ray, as well as on photoelectric cells like the selenium and the alkali cell for use as generators and arc lamps for diffusion of the rays. A system resulting from the researches of Simon, Siemans and Thirring was devised and put into use in the summer of 1918. (Continued in the August number, which also contains cuts of the apparatus devised.)

DEVELOPMENT OF THE WEATHER SERVICE IN GERMANY.

This account by Dr. Kolzer covers the main features of progress made in the last decade in making weather news available for the army, navy, air forces and the general public.

August, 1930

DEVELOPMENT OF THE GAS MASK FOR ARMY AND CIVILIAN USE.

One may see, by perusal of this article, how German manufacturers have improved the gas mask since the war. The models shown in the illustrations are of masks made by the German Incandescent Light Co., Ltd., for both troops and civilians.

Zeitschrift fur Das Gesamte Schiess-Und Sprengstoffwesen

May, 1930

THE EROSION OF GUN BARRELS.

A discussion by D. C. McNair of the various theories advanced for the cause of erosion and of what has been done to mitigate or prevent this defect.

PROTECTION OF PERSONNEL IN THE EXPLOSIVES INDUSTRY.

Some account is here given of the laws and regulations now in force in Germany for protecting operatives in this industry against accidents occurring in the manufacture of explosives.

June, 1930

UNDER-WATER EXPLOSIONS.

THE ABSORPTIONS OF GASES AND VAPORS BY MEANS OF ACTIVE CARBONS AND THE ISOLATION OF ABSORBED PRODUCTS FROM THE SAME.

COMMERCIAL SIGNIFICANCE OF AROMATIC NITRO COMPOUNDS

July, 1930

NITRO STARCHES.

These starches, whether in a pure state or mixed with other substances, are not used in Germany either in the military or the civil explosive industry. The cause, according to Escales, is their insufficient stability and great hygroscopicity, which is markedly higher than in the case of other cellulose nitrates. The American explosives industries must have completely overcome these difficulties since we read in the "History of the Explosives Industry in America," by Van Gelder and Schlatter, that the plants of the Trojan Powder Company in Pennsylvania and California had an output of these of 50,000,000 pounds a year.

MATHIESON
EAGLE-THISTLE
CHEMICALS

Mathieson Chemicals

SODA ASH
CAUSTIC SODA
LIQUID CHLORINE
BLEACHING POWDER
BICARBONATE OF SODA
AMMONIA
Anhydrous and Aqua
H T H *{Hypochlorite}*
PURITE *{Fused Soda Ash}*
SULPHUR DICHLORIDE

The MATHIESON ALKALI WORKS *{Inc}*
250 PARK AVENUE NEW YORK CITY
PHILADELPHIA CHICAGO PROVIDENCE
CHARLOTTE CINCINNATI
WORKS:
NIAGARA FALLS, NEW YORK SALTVILLE, VIRGINIA

The Shot Shell that is Famous for its Long-Range and *Short* Shot String

The effective long-range and **Short** Shot String of Western **Super-X** shells have made them the choice of duck hunters the country over. The shot charge travels through the air in a compact mass, instead of stringing out. More pellets reach the bird. For Quail shooting and other upland game there is nothing like Western **Field** and **Xpert** shells.

BRASS MILL DIVISION

Highest quality Brass, Bronze, Phosphor Bronze, Nickel Silver; also special alloys for special purposes, supplied in rolls, sheets, strips, plates, circles. Stamped and drawn parts, fabricated from non-ferrous alloys and supplied to other manufacturers. Our technical men will gladly help solve your problems.

Western Super-X
THE LONG RANGE LOAD

WESTERN CARTRIDGE COMPANY, EAST ALTON, ILL., U.S.A.

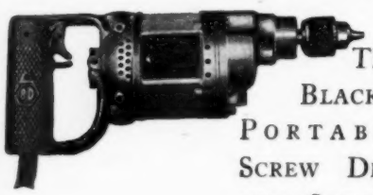
The CONDOR takes its place in the Nation's Air Armada

NOW—Curtiss adds the Condor Bomber to the select group of high-performance Curtiss aircraft in the service of our military and naval air organizations.

Designed for the U. S. Army Air Corps, the Condor excels in speed, climb, ceiling, range and military load the performance of any American bomber in service. It is a worthy addition to Curtiss' 20-year record of engineering and building fine military aircraft and engines. Curtiss Aeroplane and Motor Co., Inc., Garden City and Buffalo, N. Y.

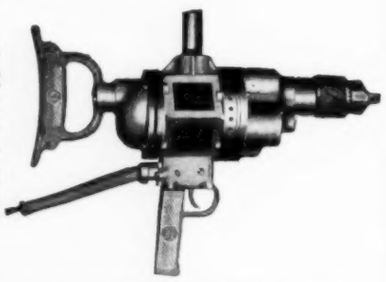
CURTISS AEROPLANE AND MOTOR CO.

BLACK & DECKER
Portable Electric Tools
"With the Pistol Grip and Trigger Switch"



There is a BLACK & DECKER PORTABLE ELECTRIC SCREW DRIVER, ELECTRIC SOCKET WRENCH, ELECTRIC TAPPER, ELECTRIC GRINDER or BUFFER for every need.

These tools are rendering the highest type of service in every civilized country in the world.



The BLACK & DECKER MFG. CO.
TOWSON, MD.

Germany could not busy herself with the solution of this problem during the war since the use of starches as raw material in the explosives industry had a marked and a very far-reaching influence on the food supply of the nation.

A New Universal Explosive.

This is an abstract of a lecture delivered at the annual meeting of the German Chemical Society at Frankfort-on-Main, June 14, 1930, by Dr. Alfred Stettbacher, of Zurich. In a previous lecture he had described the properties of a high-power military explosive invented by himself and which he named *Penthrinit*. In the present discourse he expatiates on the use of this compound in industry.

August, 1930

A Contribution to the Theory of Mines.

Flame and Sparks in Firing.

The Soldier in Gas Warfare.

Review of an article by Dr. Raoul Mercier which appeared in the June, 1929, number of the *Revue d'Artillerie*, on this subject. Prof. Mercier recounts interestingly the effects of certain German gas attacks in the World War.

GREAT BRITAIN

The Army, Navy and Air Force Gazette

July 3, 1930

A New American All-Purpose Gun Carriage.

The data here given are abstracted from an article by Major G. M. Barnes, Chief of the Design Section, Watertown Arsenal, Watertown, Mass. Major Barnes' article appeared in the May-June, 1930, issue of Army Ordnance, and is entitled "A New Weapon for Field Artillery." The carriage is that designed for the 75-mm. field gun. Two of the cuts illustrating the carriage are reproduced.

August 14, 1930

The Thoughts of a Soldier.

A review of a book under this title, by that clear thinker and interesting writer, General von Seekt. The book, which has been translated into English by Gilbert Woodhouse, is said to be a series of essays on different aspects of the art of war. An extract from the review quoting the General on "Modern Armies" is worth while: "To what military success did this universal levy in mass, this gigantic parade of armies, lead? In spite of every effort the war did not end with the decisive destruction of the enemy on the field of battle; for the most part it resolved itself into a series of exhausting struggles for position until, in the face of an immense superiority of force, the springs which fed the resistance of one of the combatants, the sources of its *personnel*, its material, and finally of its morale, dried up, although they were not exhausted. Has the victor really rejoiced in his victory? Do the results of the war bear any just relation to the sacrifice of national strength? Is it necessary for whole nations to hurl themselves upon one another whenever recourse to arms is unavoidable? The soldier must ask himself whether these giant armies can even be maneuvered in accordance with a strategy that seeks a decision, and whether it is possible for any future war between these masses to end otherwise than in indecisive rigidity."

The 1930 Air Exercise.

These are not to be carried out over London, nor to have as an object the bombing and defense of that city. "This

year, a totally different scheme has been drawn up for the operations. It has nothing to do with home defense or the safeguarding of any vital point in England." In imagination all the fighting is to take place in an island overseas. "The main object of the exercises," we are told, "is to provide opportunities for extended operations which will give as much scope as possible for the skill and initiative of the squadron leaders and wing commanders."

A TEST OF THE MADSEN GUN.

While there is no prospect at present that this light machine gun will take the place of the Vickers gun now standard in the British Army, the test given it at Bisley demonstrated its excellence. During the test "30,000 rounds of service ammunition were fired, the barrels having been apparently modified for this purpose. Of these 9,600 rounds were fired consecutively, magazine after magazine. The two barrels supplied with each gun were used in alternation as each became too hot. Single rounds were fired as also were bursts of five. A rusty barrel was used without disaster and sand was distributed over another without any interruption of the rate of fire or, it is said, of the accuracy of fire." The test was made in a new attempt to induce the War Office to adopt the Madsen as a standard weapon.

August 28, 1930

CHEMICAL WARFARE EXPERIMENTS ON ANIMALS.

Under this heading we find a short tabulation of the results of experiments carried out at the Experiment Station at Porton, July 10, 1929, to July 30, 1930, and at the Physiological Laboratory, Cambridge, January 1, 1929, to July 30, 1930. At the station first mentioned 620 animals were used, 244 were killed by the experiment, leaving 376 surviving, none of which was destroyed afterwards as a result of the effects. At the second named station 280 animals were experimented upon, 233 were killed and none had to be destroyed afterwards. The animals used comprised rabbits, guinea pigs, cats, goats, mice, sheep, horses, rats, cats and pigeons. It is notable that of 8 horses used none died and of 10 goats only one died, and in neither of these latter cases were there any permanent effects on the remainder.

September 11, 1930

THE SOLDIER MECHANIC—A PROBLEM OF THE TIMES.

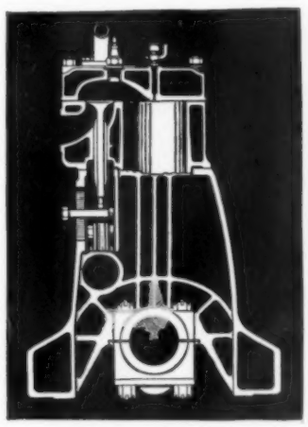
As an army is said to travel on its stomach a mechanized force travels on its supplies. Adequate maintenance and repair are absolutely necessary to it and it will have to rely almost entirely on supplies brought up from its base of operations. Of these the most vital will be stores which insure the immediate and continued movement of the vehicle—petrol, oil, grease and standardized spares. How will repair be carried out? Two systems are suggested (a) centralized repair by the highly skilled personnel in mobile workshops, or (b) a combination of rough and ready decentralized replacement repair by the fighting soldier on the battlefield and expert repair in workshops removed from the battle area for those machines damaged beyond the capacity of the vehicle crews. The first is not favored by the author because it is physically impossible for a central organization to attend to the vast repairs needed in modern battle, and the second has not yet had time to arrive in military circles. The subject is further considered in the September 18, 1930, number of the Gazette.

For Industrial Use
We are Prepared to Furnish

8½"-120,
8½"-150,
10½",
Cross Compound
Compressors.
Also the New
High Pressure 7⅝" Cross Compound
Compressor for Superheat Steam

The New York Air Brake Co.
420 Lexington Ave. NEW YORK

STRONG
AND
DEEP



"Girder" Crankcase

Waukesha's "girder" type crankcase is designed for extra rigidity, both in bending and in torsion. The steel backed bearing caps are held by four heat-treated alloy steel stud bolts. Reciprocating parts are closely paired and accurately balanced. Not only is objectional vibration thus eliminated but the combining of "girder" crankcase, rigid bearing and crankshaft construction is an exclusive Waukesha feature that makes double flywheels or dampeners unnecessary.

WAUKESHA
ENGINES
WAUKESHA WISCONSIN

1855 · SEVENTY-FIFTH ANNIVERSARY · 1930

194 branches and sales offices are ready to co-operate on piping needs

Army buyers, stationed in San Francisco, San Antonio, New York, or anywhere else in the United States, when in need of plumbing or heating materials, will find a nearby Crane branch ready to give all information and co-operation.

For better service, both in buying and delivering, Crane Co. maintains 194 branches and sales offices, manned by experienced representatives. These will be especially pleased to assist army purchasers, whether they are seeking a fitting or faucet for a small repair job; plumbing and heating for a building; or a complete piping material layout for an engineering job as big as the Panama Canal.

Valves CRANE Fittings

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO
NEW YORK OFFICES: 23 WEST 44TH STREET
Branches and Sales Offices in One Hundred and Ninety-four Cities

There's Power in WARCO Rear Crawlers

Whether hauling cannons, wagon trains, or loads of logs in the north woods, WARCO rear-type crawlers give traction to the tractor enabling it to pull where wheels would be helpless.

Advantages of rear crawlers are easier steering, and faster travel without sacrifice of pulling power or bearing area.

W. A. RIDDELL COMPANY
BUCYRUS OHIO

Road Building Machinery — Clay Plant Machinery
Manganese and Carbon Steel Castings

September 18, 1930

A BRITISH MACHINE-MADE RIFLE.

"The Vickers-Berthier Machine rifle is a gas-operated automatic weapon of simple design and light weight. It resembles a rifle in appearance, and is little more than double the weight of the present service rifle (either Mark III, Mark IV or Mark III*). It can be disassembled speedily into five principal sections. . . ." A table is embodied in the text giving comparative figures for this gun as compared with the Lewis, Hotchkiss and Madsen guns.

ITALY

Revista Di Artiglieria E Genio

August, 1930

OUR POST-WAR ARTILLERY.

The best method of substituting this matériel with guns of greater fire power and greater mobility is here discussed at considerable length, with some considerations on the influence of mechanization upon the problem in hand.

OBSERVATIONS OF COUNT DE SPARRE ON PROF. BURZIO'S TESTS ON AIR RESISTANCE.

With permission of both the above named authorities three letters of Count de Sparre, the illustrious French ballistician, to Prof. Burzio are here published in translation. These letters are said to throw considerable light on the resistance of the air to projectiles, an important problem of exterior ballistics.

ITALIAN MILITARY ENGINEERS IN HUNGARY AND ESPECIALLY IN AGRIA.

During the reign of the illustrious king Matthias Corvinus in the middle of the XV century numerous Italian military engineers are believed to have gone to Hungary, called thither by Cardinal Gabriele Ragoni of Verona, Grand Chancellor of the King, for the purpose of restoring and erecting fortifications. To lovers of old fortifications this article should make an appeal. There is a copious bibliography on this subject.

September, 1930

RADIOPHONE COMMUNICATIONS FOR ARTILLERY.

A 41-page discussion of this subject covering all its phases.

TETRANITRATE OF PENTAERITRITE (PENTRITE).

EQUILIBRATORS.

Revista Aeronautica

June, 1930

A GLANCE AT THE PROGRESS OF MILITARY AVIATION IN THE SMALLER STATES OF EUROPE.

It is in such countries that the author believes the Italian airplane industry will find promising markets. To show what may be done, he cites a country like Switzerland, which is increasing its air forces and which he evidently considers, and with reason, a typical minor power. For convenience of reference, he lists all the smaller countries, from those with a population of over 20,000,000 to those with less than 2,000,000 inhabitants.

RADIO IN AVIATION.

The problems met in the use of radio-telegraphic apparatus aboard airplanes are here treated at some length—and very interestingly—by Capt. Giovanni Manisco. The article is copiously illustrated.

ARE POPULAR EDUCATION IN AERONAUTICS AND THE GROWTH OF THE AIR ARM REALLY ACTIVE FACTORS IN CAUSING WAR?

Ercole Morelli denies categorically that these influence the growing generation to fight and his arguments certainly are convincing. The occasion for the paper was the appearance of an Italian translation of a book by Commander Kenworthy, of the British Navy, a member of Parliament and head of the General Staff at Gibraltar. The thesis of this book is that the terrific potency of modern weapons, especially the air arm, would in the next war effect the ruin of civilization and that the people should not be educated in their use and all displays of force should be avoided.

July, 1930

HIGH PRESSURE AIRPLANE MOTORS.

The author examines the various types of compressors, the difficulties and advantages met with in their use and the results obtained in various applications. He then discusses their feasibility, concluding that the use of high pressure (*suralimentaziones*) is only practicable in motors constructed for the highest quotas and with propellers of variable pitch.

A CONTRIBUTION TO THE THEME OF THE USE OF GIANT AEROPLANES.

The author argues that while such planes have their place in the air forces they should be used for exceptional tasks only, and not generally, principally because they are easy targets for antiaireraft fire.

August, 1930

CONSIDERATIONS ON THE USE OF ASTRONOMICAL NAVIGATION IN FLIGHT.

After some observations on the necessity of this method for flight purposes the writer sets forth some ideas of his own on better applications of the method for the purpose indicated.

THE PROBLEM OF MODERN AIRPORTS.

SPAIN

La Guerra Y Su Preparacion

June, 1930

THE KELLOGG PACT AND THE PEACE PROBLEM.

A lecture delivered at the Cavalry School, Valladolid, March 14, 1930, by Lieut. Auditor C. O. Perez. After discussing the circumstances surrounding the formation of the pact he sets forth the reasons why he regards it as a measure which can do nothing more than become a gesture for the suppression of wars. "Man seeks," he says, "to suppress future wars and is not wise enough to discover the origin of those of the past." "Only a genuine coöperation between states for economic, social or scientific ends; only labor over which a common interest presides . . . can constitute the way to future happiness."

August, 1930

GERMAN AND AUSTRO-HUNGARIAN LEADERSHIP DURING THE WORLD WAR.

Takes up the narrative from the time when General von Falkenhayn, then Minister of War of Prussia, took command of the Great General Staff of the German Army (i. e., September 14, 1914), after the first Battle of the Marne.

THE OCCUPATION OF FEZZAN BY ITALIAN TROOPS.

This occupation was carried out by Meharist troops aided by the air forces of the Italian Army during 1929-1930.

Hercules Powder Co.
Wilmington, Del.

High Explosives
Smokeless Powders
Blasting Supplies
Nitrocellulose
Naval Stores

An Automotive
Muffler
that stands
Punishment

For every motor—every car, truck, bus, tank, tractor, plane and dirigible—a muffler built to outlast the engine—built to stand hard service — the PRATT CHUCK MUFFLER. Its corrugated nested cup construction adds strength to efficiency—the muffler that will not blow out.

PRATT CHUCK CO.
Frankfort, N. Y.

4276

TROJAN EXPLOSIVES

High Explosives
for
every blasting purpose

NON-FREEZING!
NON-HEADACHE!

TROJAN POWDER COMPANY
Allentown, Penna.

Chicago **Portland** **San Francisco**

AGATHON STEELS
TRADE MARK

The famous family of steel products under the Agathon trade-mark includes Alloy Steels, Special Finish Sheets as well as all standard finishes, Electrical Sheets, Hot Rolled Strip, Toncan Enameling Iron, Toncan Oven-Lining, Galvannealed Sheets and Enduro Stainless Iron.

CENTRAL ALLOY STEEL CORPORATION
Massillon, Ohio
World's largest and most highly specialized alloy steel producers

35% Saved!

Net Wt. 51 Lbs.

On less than 1000 of these forgings one customer saved $2475.00 in material cost. He saved the paying of unnecessary freight and the machining of unnecessary stock, as our product was held closer to the finished sizes.

AMFORGE

This great saving in material alone was the result of changing material specifications from "cast steel" to "AmForge."

Our engineering department is at your service. Its advice on designs for upset production has saved thousands of dollars in labor and material for our customers.

Send for Booklet

American Forge Co.
2623 So. Hoyne Ave. **Chicago, Ill.**

Army Ordnance

The Journal of the Army Ordnance Association

AN internationally recognized repository of technical and scientific information concerning current military armament. Its principal function is the dissemination of authentic data on industrial preparedness and munitions development to the members of the Army Ordnance Association to whom it is furnished bimonthly as one of the privileges of membership. The journal may be subscribed for by non-members. The annual subscription rates, payable in advance, are: to domestic destinations $4.50, foreign $5.00.

Orders for subscriptions should be addressed to:

THE ARMY ORDNANCE ASSOCIATION,
THE MILLS BUILDING,
WASHINGTON, D. C.